MARCH • 1956
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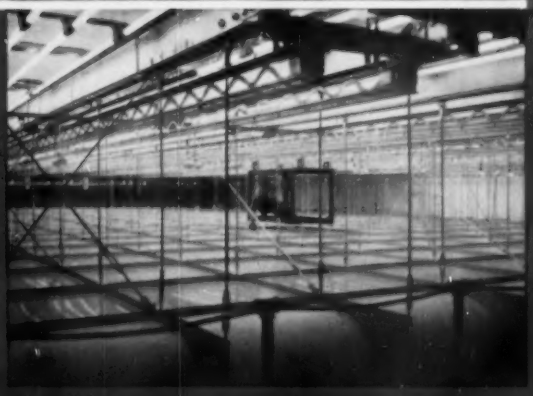
ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

First of new skyscrapers in Philadelphia's Penn Center development has vertical bus, remote control, and dual electrical services. page 66

SHOPPING CENTER ELECTRICAL DESIGN

First of a series on the layout of electrical work for new suburban mercantile centers. page 63



Art museum electrical installation features novel lighting, maintenance and protection systems. page 76

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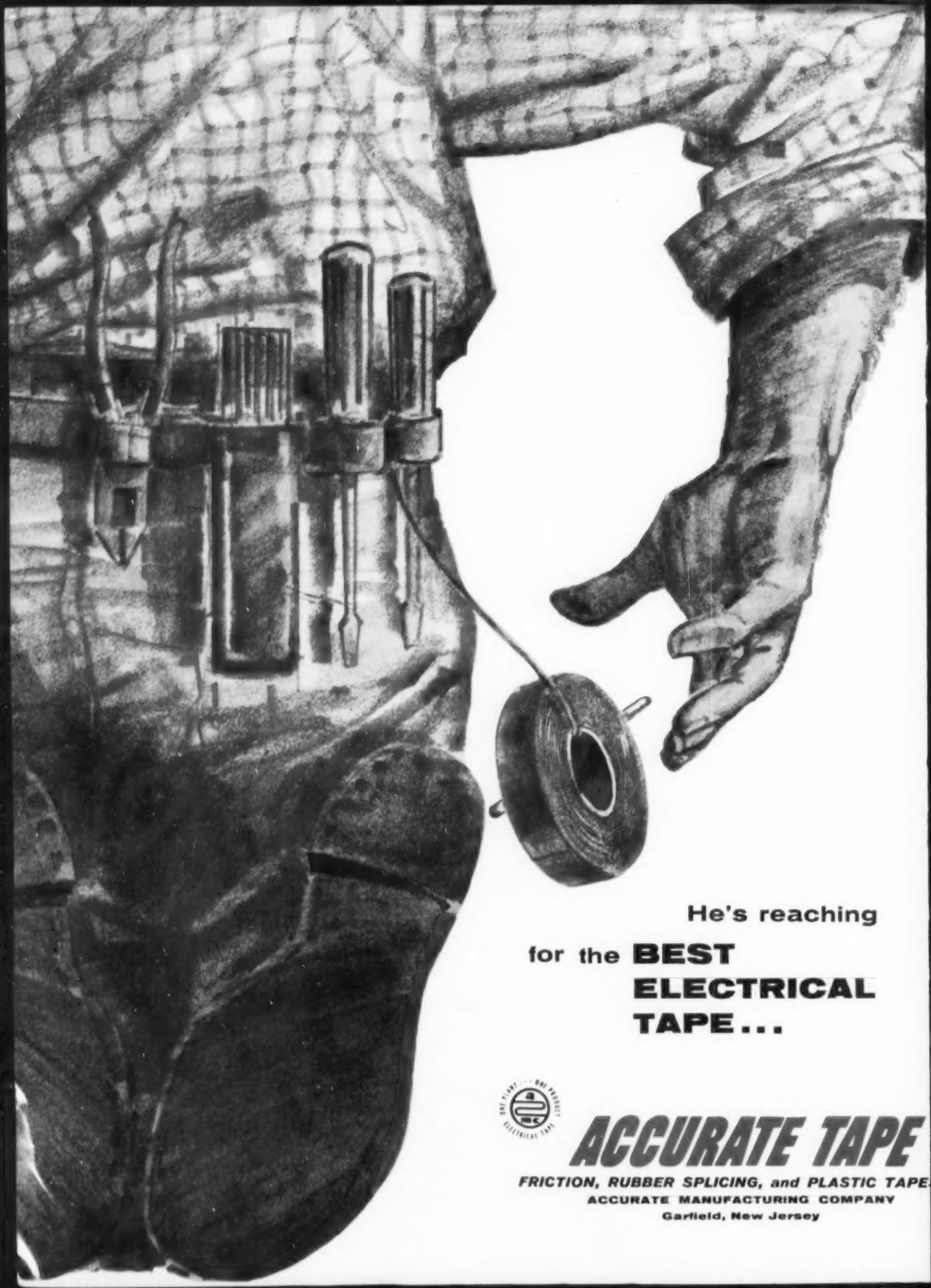

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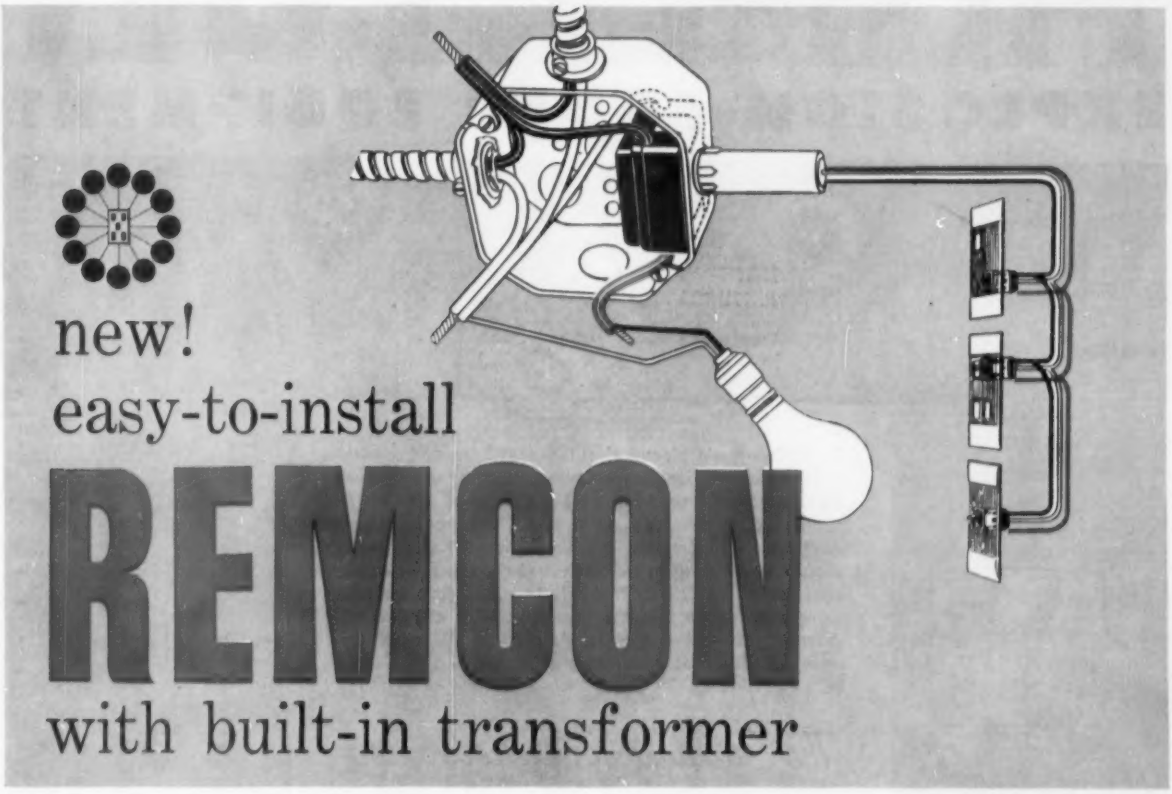

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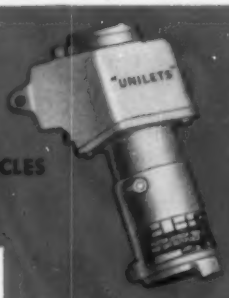

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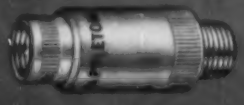

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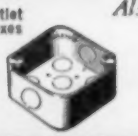

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Sidelights

SUPER-INSULATION – Super-insulation of electrically heated premises to control heat loss often results in nearly airtight construction. Infiltration, the usual source of air change in homes, can be reduced to the point where some means of controlled ventilation must be provided.

The problem appears to be twofold; the introduction of a controlled amount of tempered fresh air and the exhausting of odor-laden or stale air at an optimum or controllable rate that will not introduce excessive or wasteful heat loss.

Some of our readers may have had practical experience with this problem and its solution. The editors would appreciate suggestions or experience data bearing a practical solution to such problems.

PENN CENTER–Rarely does a major city have the opportunity to completely revamp its business center, yet this is the dramatic change now taking place on a 2-acre site in the heart of Philadelphia. New construction estimated to eventually exceed $300-million is already evident in the forms of a 20-story office skyscraper and pacesetting newspaper plant. Steel skeletons for a thousand-room hotel and mammoth transportation center are also rising, while dozens of additional buildings are in the planning stage. Here in this issue is a discussion of the skyscraper–a modern structure having vertical busduct distribution, numerous remote controls, complete air conditioning and dual electrical services. Contractor on the job was the Harry F. Ortlip Company. You'll find the story under the title, "Penn Center Rebuilds" on page 66.

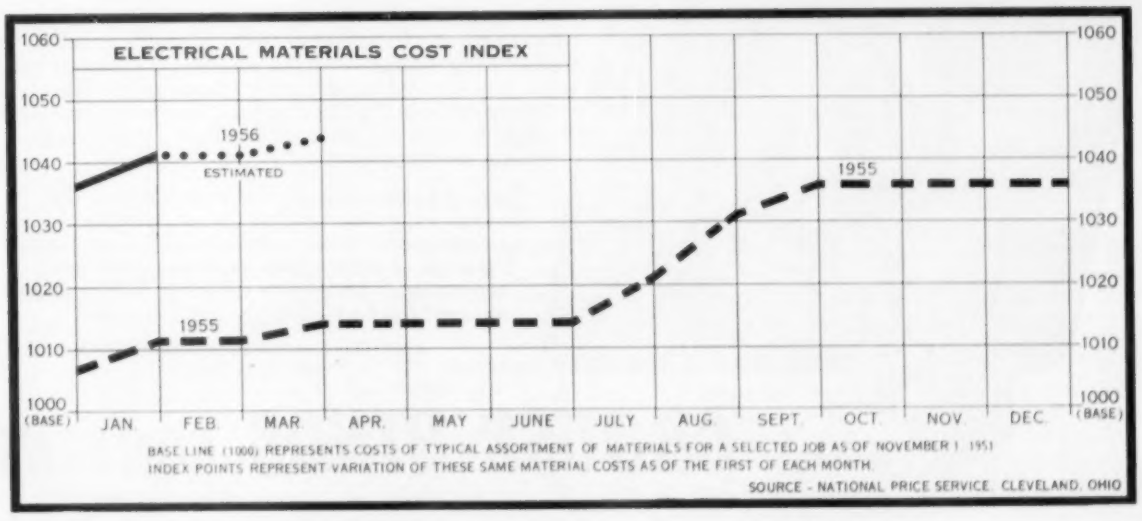
MUSEUM–An art museum having an unusually flexible lighting system, complete with dimmers, relay switching and automatic skylight louvers activated by photocells, has just been completed in Williamstown, Mass. Wired by Hixon of Boston, the building also incorporates dozens of electrical devices related to fire and theft protection, temperature and humidity conditioning. Ground covered by this building is not great; yet, in terms of beauty, electrical design, scope of services and quality of workmanship, this job ranks with the finest in the country. We recommend that you read "Lighting and Protection for an Art Museum" on page 76.

DESIGN DATA–From survey returns and readers' inquiries, we note an increasing interest among electrical contractors in practical electric heating design and application data. Your heating equipment supplier should be able to provide comprehensive data for the installation of the products he carries, if not, most of the heating equipment manufacturers will furnish such data on request.

If you have kept your Mid-September Electrical Products Guide issue of *Electrical Construction & Maintenance* handy, you will find a complete summary of essential calculations in the Technical Data Reference Section under Electric Space Heating Data, pages 50-56.

SHOPPING CENTERS–The suburban shopping center is one of newer commercial phenomena of our time. Population growth and housing developments spreading outward from urban centers combined with decay of mass transportation and mounting urban traffic and parking problems, have spurred the development of branch merchandising in readily accessible shopping centers.

The plot planning and the types of structures used for shopping centers present many novel problems of electrical design and layout. In response to wide interest in the subject among engineers and electrical contractors, we are presenting a series of articles prepared by R. J. Abramson, Consulting Engineer, Chicago, Ill. The first, "Fundamentals of Shopping Center Electrical System" begins on page 63.



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Washington Report

Industrial output averaged the highest in history during 1955 for a record FRB index of 139 average for the year. This compared with 125 for 1954, and 134 for 1953. Previous high was set at 127 during wartime 1943. Output in January of this year was 143, a 2 point gain over December, and an 11 point increase over January of last year. Department of Commerce reported gross national product for 1955 at $387.2 billion, 7½% above 1954, 6% over 1953. Rate during last quarter of 1955 was $397.3 billion.

Total personal income in 1955 was $303.3 billion, up $15.7 billion over 1954, and ended the year at an annual rate of $315 billion.

Employment in mid-January set a new record at 62.9 million, down 1.3 million from December but up 2.7 million over a year ago. Unemployment also went up, to 2.9 million in mid-January, 450,000 above December but 450,000 below a year earlier. Employment in non-agricultural industries during 1955 averaged 49.4 million, up 1.1 million over average for 1954. Production workers in manufacturing industries averaged $76.63 per week for work-weeks of 40.7 hours working time. Gross hourly rate averaged $1.88.

Consumers owed $36.2 billion for goods and services at the end of 1955, up $6.1 billion in the year (a record), and up $15.4 billion in the past five years. Consumers added $648 million to their instalment debt during December. FRB and Government officials predicted a slowdown in instalment buying for January and February. Repair and modernization loans increased $7 million in December compared with a $15 million decline in December a year earlier.

Domestic price of copper was upped to 46 cents a pound last month by the nation's major producers. Prices for fabricated products were also raised to conform to the new quotation for refined copper.

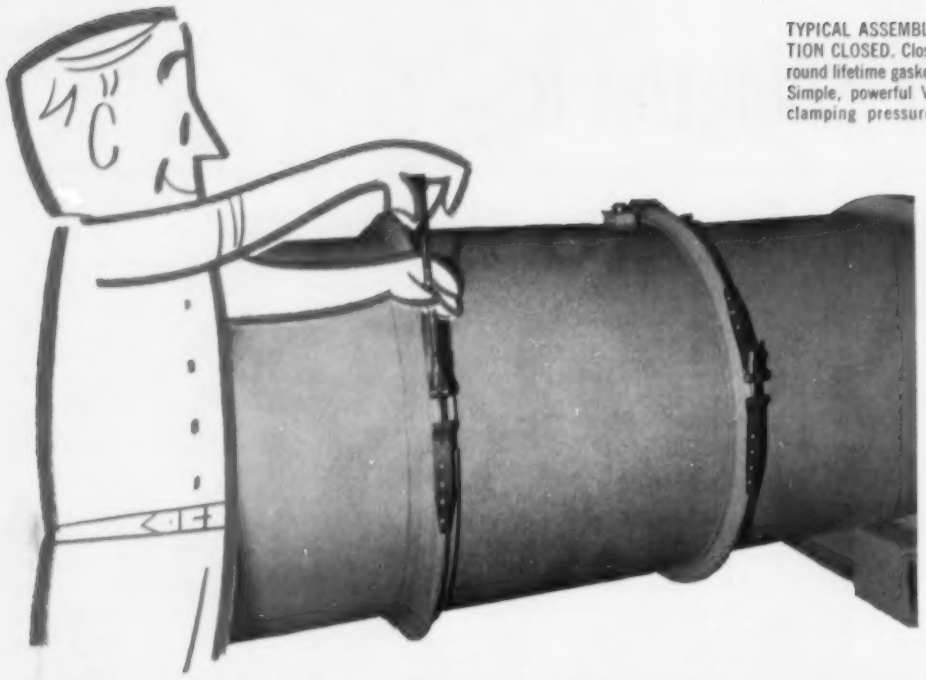
Production of refined copper in 1955 was a record 1,467,448 tons, compared with previous high of 1,395,000 tons in 1953. Production in 1954 was 1,311,031 tons.

Building up a five-year stockpile of strategic materials will be continued, officials of ODM and National Security Council and others decided, following a study based on new emphasis of preparation for a short war. Amounts and kinds of strategic materials involved are kept secret, but the list obviously includes many metals and materials already in tight supply and in use by the electrical industry. New policy includes less cash buying, more bartering, for these stockpile items.

A ten-year atomic power plant development program with the Government putting $5 billion into it over the next five years was urged on Congress recently by AEC Commissioner Thomas E. Murray "to maintain our lead (over Russia) in the atomic power race". His proposal would add two million kw by 1960, another eight million kw between 1960 and 1965.

Distribution of electric energy in 1955 hit a record 545 billion kwhr, compared with 472 billion in 1954, 443 billion in 1953, and 329 billion in 1950. Current rate of distribution is running in excess of 11.5 billion kwhr weekly.

Housing starts in January declined to 74,000 units, down from 75,000 in December and 87,600 units a year earlier. FHA announced an 18% increase in applications for home mortgage insurance, however, as building reports from across the nation show demand rising as mortgage credit eases. The housing slowdown, which began last September, followed the Government's modest curbs on mortgage credit, which in turn has been blamed for most of the slowdown. Building dollar volume remains high.



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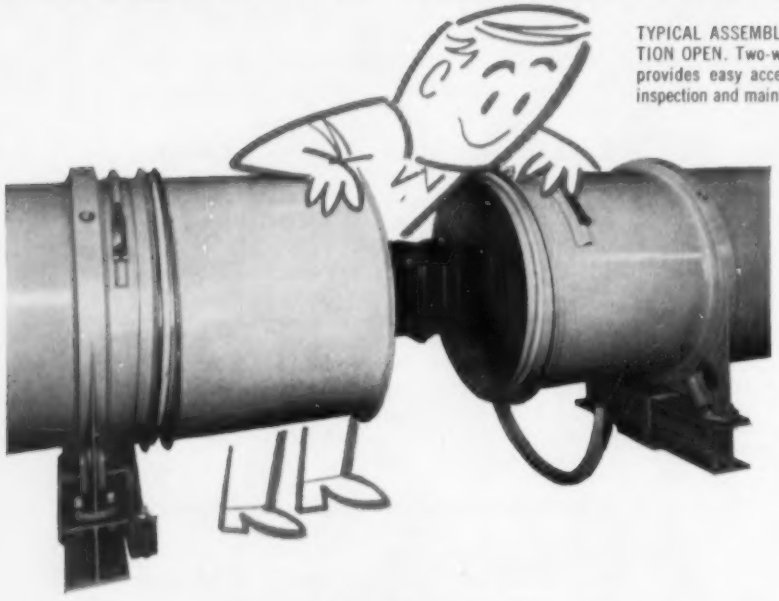

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Bulletins 10004-A and 10004-B describe I-T-E Isolated Phase Bus designs. For copies of these bulletins, write I-T-E Circuit Breaker Company, 19th and Hamilton Sts., Phila. 30, Pa.

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Business Investment Holds Key To Both Growth and Stability

What federal tax policy will best promote both growth and stability in the American economy? The Joint Economic Committee of Congress has been asking this crucially important question in public hearings. This editorial suggests one vital part of the answer.

The proposition advanced here is that—

> Tax policy must encourage a continuing high level of business investment in new plant and equipment, because such investment makes a special contribution to *both* economic growth and economic stability.

Growth Needed for Security

We must have both growth and stability.

A vigorous economic growth is essential to our national security. As Congressman Wilbur D. Mills said in launching the Joint Committee's hearings, "The present complexion of world affairs places a premium upon strength and growth in our national economy." Growth is likewise a major ingredient of a healthy domestic economy. Growing enterprises and growing communities offer far more opportunities for satisfying careers than those which are not growing.

A reasonably stable economy, without violent ups and downs, is also essential to our national welfare. Extravagant booms and their more or less inevitable result, severe depressions, waste labor and resources and cause great human misery. Both major political parties have accepted the obligation imposed by the Employment Act of 1946, that the federal government work to maintain high and stable employment.

There is general agreement that **the key to economic growth is investment in new plant and equipment.** Growth depends decisively on new facilities to increase production, and also to produce new and better products in new and better ways. At the same time, new plant investment provides employment for the important, and well-paid, one-fourth of our industrial workers who manufacture and build new production facilities. So if the process of business investment is kept on an even keel, the result is not only growth but also stability in a substantial sector of our economy.

But authorities disagree on the possibility of maintaining a high level of business investment for any great length of time. Some fear that it will lead to an excess of producing capacity and the glutting of markets, with recession or depression not far behind.

The history of our country offers some basis for the fear that it is dangerous to maintain a very high level of business investment. There have been times when the economy has suffered under the weight of excess producing capacity. **This fear, however, has been made obsolete by the recent course of our economic history which, in its earlier phases, nourished the fear.**

The World Has Changed

Here are some of the major considerations, cited at the Joint Committee hearings, which support the conclusion that we not only *can have* a high level of business investment and economic stability but that we actually *need* a high level of such investment to assure stability.

(1) Over the next 20 years our population is expected to increase by about one-third. But most of the population increase will come in age groups younger or older than normal working ages, and people will probably work fewer hours per week. Thus hours worked are not expected to increase more than 15%. Consequently, we must have a relatively large increase in the amount of production equipment per worker if our standard of living is not to suffer. This means a high level of new investment.

(2) About half of our present business investment goes to replace worn-out equipment, rather than to expand capacity as was true during the early stages of our industrial development.

(3) Thanks largely to the impact of organized research—for which we as a nation now spend about $4 billion a year—a large share of capital investment now goes to provide new products and new processes, rather than to expand existing capacity.

These developments make it unlikely that we shall develop the burden of excess capacity that plagued the economy in earlier periods. **Moreover, most capital investment plans are now made on a long-range basis. Companies are building facilities to anticipate their needs for several years ahead.** This increase in long-range planning has reduced the disturbing effects of temporary shortages and excesses in producing capacity.

The record of recent years speaks for itself. Business spending for new plant and equipment in 1955 was over $29 billion. This continued the high level of investment that has been maintained for the past ten years—a decade remarkable for both impressive growth and gratifying stability. A McGraw-Hill survey of preliminary plans for 1956 indicates another year of increasing investment, and expanding business activity.

Tax policy, to be successful, must consider this impressive contribution of business investment to both growth and stability.

Of course, the level of investment depends on many factors other than federal tax policy. The degree of business confidence is important. So is the strength of consumer markets. So is the attitude of organized labor toward the use of more efficient machinery. But tax policy is a crucially important factor. And it is becoming more so with new developments in our changing economy. These developments indicate that tax policy **must be geared to foster a high level of business investment, if the dual objectives of economic growth and economic stability are surely to be attained.**

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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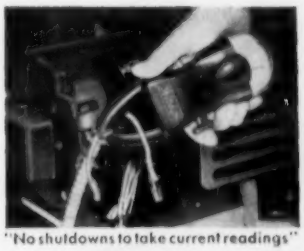
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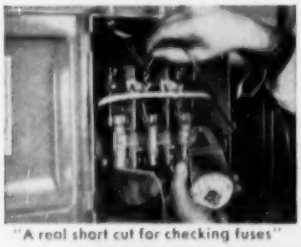
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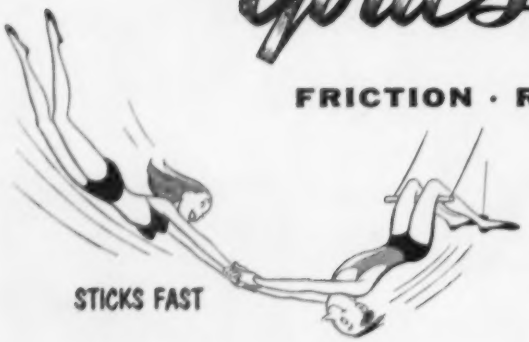

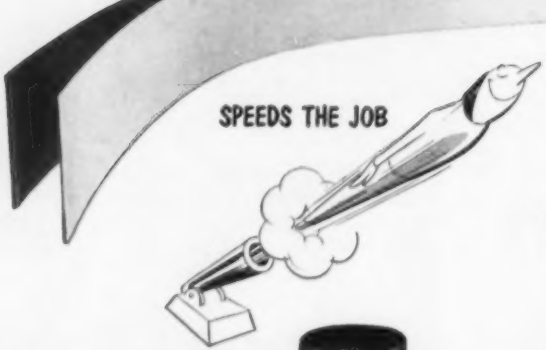

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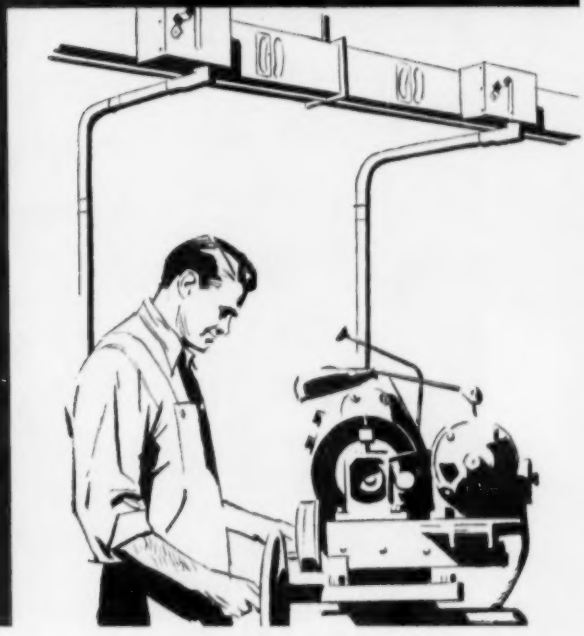

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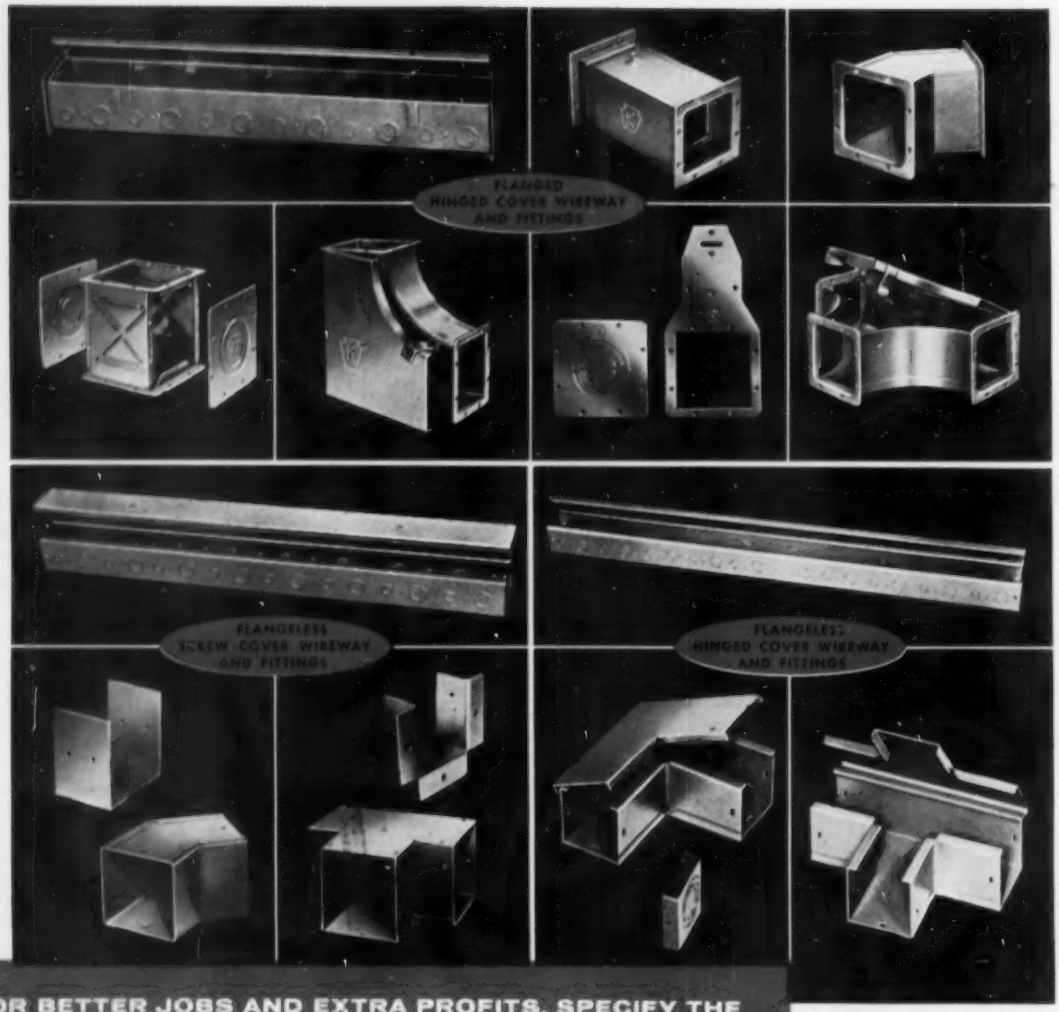
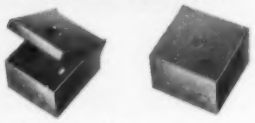
Export Division: 13 East 40th Street, New York 16, N. Y. • *In Canada:* BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Road, Toronto 15, Ont.

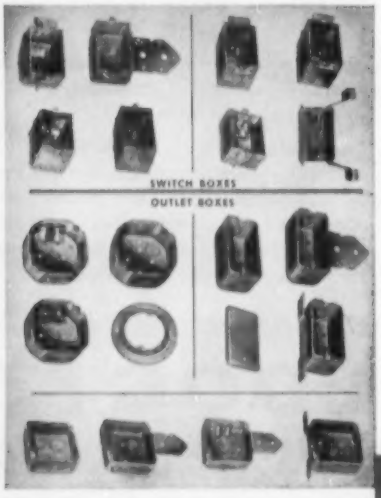


FOR BETTER JOBS AND EXTRA PROFITS, SPECIFY THE

KEYSTONE QUALITY LINE

CABINETS AND PULL BOXES





No doubt about it! When it comes to wiring installation jobs, you can get *what* you want *when* you want it from the Keystone Quality Line. Wireways, for example, are available in both flanged and flangeless styles . . . with hinged or screw covers . . . with or without knockouts . . . and in sizes ranging from 2½″ x 2½″ x 1′ through 8″ x 8″ x 5′. There's a wide selection of auxiliary fittings to choose from, too, plus cutout boxes and pull boxes in more than 50 different stock sizes . . . and a variety of telephone and current transformer cabinets to meet your exact requirements. And if it's outlet boxes or switch boxes you're looking for, you'll find that Keystone has them . . . in almost every type and size, with proper covers, too. What's more, every item in the Keystone Line is quality-built, priced right, and stocked for immediate shipment direct from factory warehouses! Want more information? Send for your free copy of the new illustrated Keystone catalog today!

It pays to figure on Keystone

KEYSTONE MANUFACTURING COMPANY

23328 SHERWOOD AVENUE • CENTER LINE (Detroit) MICHIGAN

. . . the Complete Line of Wiring Installation Equipment

SOLD ONLY THROUGH RECOGNIZED ELECTRICAL DISTRIBUTORS

This is no picnic for TIREX!

This photo might better be captioned, "How to ruin a good cable quickly." The scene is a slag dump, the cable is TIREX, the conditions are awful. Yet this TIREX Cable is nearly five years old.

Each time the shovel moves, it drags the cable over hot, razor-sharp chunks of slag. An ordinary cable would have given up the ghost long before, but not TIREX. It keeps working despite cuts, despite heat, despite brutal abrasive conditions.

It's the extra toughness of the cured-in-lead Selenium-Neoprene Armor that makes TIREX the preferred cable on a job like this.

If you have a job that requires the operation of portable or mobile equipment under difficult operating conditions, you should use Simplex-TIREX. You can get most sizes and styles from your local electrical wholesaler.

Why not get a length of TIREX for testing?

You'll be glad you did.

Simplex-TIREX Cable

SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Mass.

Look to these leading manufacturers for Industrial Lighting Units with the RLM Label

NOW MORE VALUABLE THAN EVER!

With continuous advancements in RLM Specifications, the RLM Label on an industrial lighting unit stands for ever-higher quality standards in lighting equipment performance and construction. Alert, forward-looking manufacturers realize that this makes the RLM Label more valuable than ever to buyers, specifiers and users of industrial lighting equipment. That is why you will recognize the 28 RLM manufacturers above as the leading names in their field . . . companies who will faithfully adhere to the RLM Standard Institute's rigid program of certification . . . firms which gladly submit to the strict RLM testing and inspection program, which assures uniform quality and conformance to standards by periodic inspection on the assembly line and in the field. Today, these manufacturers are especially proud to be able to bring you units bearing the RLM Label, because they know that it is now of even greater value to you than ever before.

Today, the RLM Label stands for higher-than-ever specifications like these:

Incandescent and Fluorescent: New High Reflection Factor. New High Light Output.

Fluorescent: All-White Porcelain Enamel Reflectors. Upward Light for more Brightness Control. Shielding Angles for less Lamp Glare.

For a complimentary copy of the 1956 RLM Specifications Book, write: RLM Standards Institute, Suite 819, 326 W. Madison St., Chicago 6, Ill.

R-1239RR

LOOK FOR MANUFACTURER'S NAME PLATE OF COMPLIANCE WITH RLM STANDARDS ELECTRICAL TESTING LABORATORIES, INC.

RLM STANDARDS INSTITUTE INCORPORATED

The Letters RLM Stand for Reflector and Lighting Equipment Manufacturers

GEDNEY'S RIGHT THERE IN YOUR CORNER

helping save time . . . hold down costs

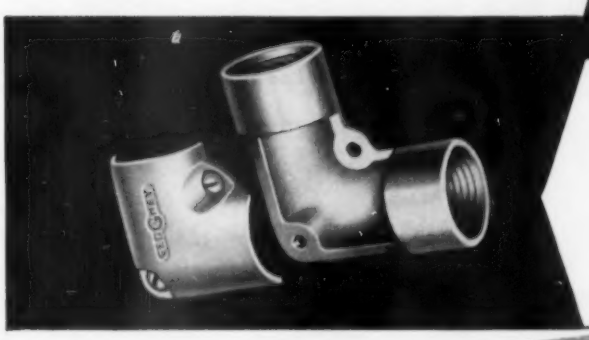
CORNER FITTINGS? Well, here are three that have proved immensely popular for the simple reason they're easiest to install – save time and labor that really counts up. Like the rest of the full Gedney line they're made of unbreakable malleable iron...accurately machined and threaded . . . individually inspected. Order Gedney – always – for lowest installed costs!

90° CORNER ELLS

Fitted with gasketed cover. Both ends female. Made of malleable iron, cadmium plated. Available in a full range of sizes from ½" to 2".

90° CORNER ADAPTERS

Fitted with gasketed cover. One end male, one end female. Made of malleable iron, cadmium plated. Your choice of sizes from ½" to 2".



CORNER PULL-IN CONDUIT ELLS

Today's top specification for space-saving, machine wiring, easy wire pulling. Malleable iron, cadmium plated. Sizes run from ½" to 2".

GEDNEY FITTINGS FIT

GEDNEY
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GEDNEY

RKO BLDG. • RADIO CITY • NEW YORK 20
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NOW-get 90°

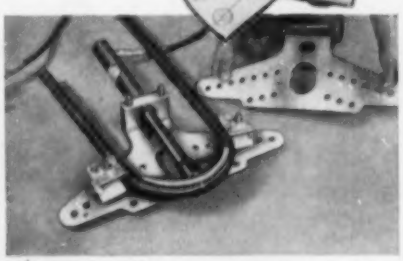
NEW S-130 BENDER — $189.00

Pays for itself on first good job. Kit includes "Porto-Power" hydraulic unit with new 10-inch stroke. 10-ton hydraulic ram plus bending equipment for six sizes of pipe and rigid conduit, ½-inch thru 2 inches.

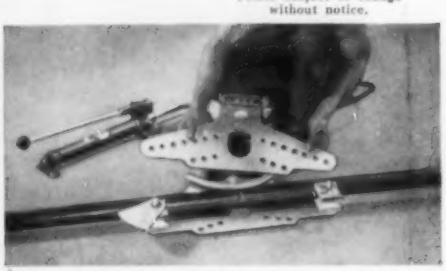
(Pat. Pending)

Prices subject to change without notice.

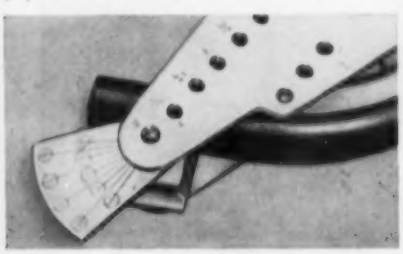
"FEATHERWEIGHT" PORTABILITY! Light but strong aluminum-alloy frame and shoes! Just a breeze to carry this bender around floor or overhead.



NEW, LONGER STROKE RAM! Extends to full 10-inches. Enables making 90° bends in one stroke. Also forms 180° bends quickly.



MAKES SETUPS IN SECONDS! Two pins unlock top plate. Pipe can be laid in from above. "Lock-on" shoes are switched in seconds.



ELIMINATES GUESSWORK, TRIAL FITTING! New exclusive "Optik-Angle" gauge records angle of bend (0° to 105°) as work progresses. It's mounted on the bender.

ALSO CORRECTS OVERBENDS! Motor-driven pump available for multiplying output of work. Ram adapts to standard "Porto-Power" attachments for lift, pull and other jack jobs.

bends in 1 setup!

NEW EXCLUSIVE FEATURES SLASH BENDING COSTS!

NEW "OPTIK-ANGLE" GAUGE

(*Patent Pending.*) At last . . . a fool-proof way to eliminate guesswork and time-wasting measuring in controlling degree of bend. The degree is constantly indicated by gauge that's mounted right on the bender.

NEW REMOVABLE TOP PLATE

This new feature makes it dramatically easy to set the shoes and position the pipe for the bending operation. There's no need to slide pipe in from the side . . . it's quickly laid in from above.

NEW LOCK-ON BENDING SHOES

No time-consuming threading of shoes on ram. Simply set shoes on plunger and pin in place. No threads to damage.

NEW "FEATHERWEIGHT" ALUMINUM ALLOY

Frame and shoes of this material are rigid and strong — yet lightweight for greater portability, easier assembly and maneuverability. Far less weight to lug around.

BENDS 6 SIZES OF PIPE AND RIGID CONDUIT

This new "featherweight" Blackhawk hydraulic bender revolutionizes bending methods. It obsoletes all other equipment for bending ½ thru 2-inch rigid conduit and pipe. Bends are made so perfectly at such amazing low cost that practically all need for expensive factory-formed ells is eliminated. All of this astounding speed, ease, lightweight and precision in bending are the result of a design which incorporates features asked for by electricians themselves. Check these advantages and you'll see why it's good business to put the new S-130 on your jobs right away! For immediate delivery or a demonstration, see your electrical wholesaler or industrial distributor today.

NEW! NEW! More time-saving Blackhawk equipment announced!

Write for literature on "New Blackhawk Equipment for Electricians". You'll get facts on the new complete line of lightweight, low-cost hydraulic knock-out punch equipment . . . the new S-130 bender . . . plus big line of other Blackhawk hydraulic tools. Write BLACKHAWK MFG. CO., Dept. , MILWAUKEE 46, WISCONSIN

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For more versatile, effective lighting

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Amplex Swivelite C12SH "Adapt-A-Unit" construction permits complete interchangeability for all parts for constantly new lighting setups.

Amplex Focalite. Won't tip over—easy to focus—most adaptable fixture for lighting displays.

Colorbeam Reflector Lamp. Amplex Colorbeams come in 14 striking colors, rated life of 2,000 hours.

Yes, the "Adapt-A-Unit" construction of Amplex Swivelite fixtures permits endless variety in achieving beauty and concentrated light for attention-getting effects... with a minimum number of basic units. These are without question the finest, most adaptable "working tools" for achieving up-to-date lighting with real *selling power*. And for more striking and colorful light, specify Amplex Spots, Floods and Colorbeam Reflector Lamps, designed especially for Amplex Swivelite fixtures. Write for new catalog describing the Swivelite *big four* exclusive features that produce effect, efficiency, economy.

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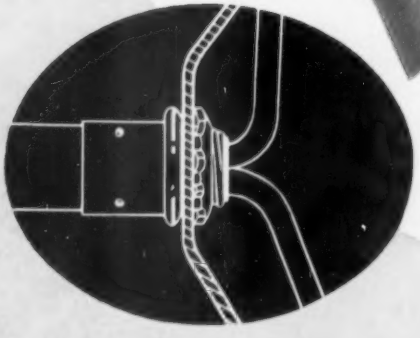
B-M 21B, THE NEW INSULATED THROAT INDENTER CONNECTOR FOR E.M.T.

Four Ways Finer



1. Protruding rounded red plastic lip of bushing prevents cutting of insulation—eliminates shorts.
2. Full thread screws into all conduit fittings. Lip of RED THROAT bushing protects thread from damage.
3. Deep dished eight pronged lock nut is easier to drive on—screws flush to shoulder and digs into metal of box for vibration proof positive ground.
4. Permanent locked-in bushing insures smooth burr-free raceway for easy fishing. No extra work and costs no more.

Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job!

ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT

Order from Your Wholesaler!

All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406.

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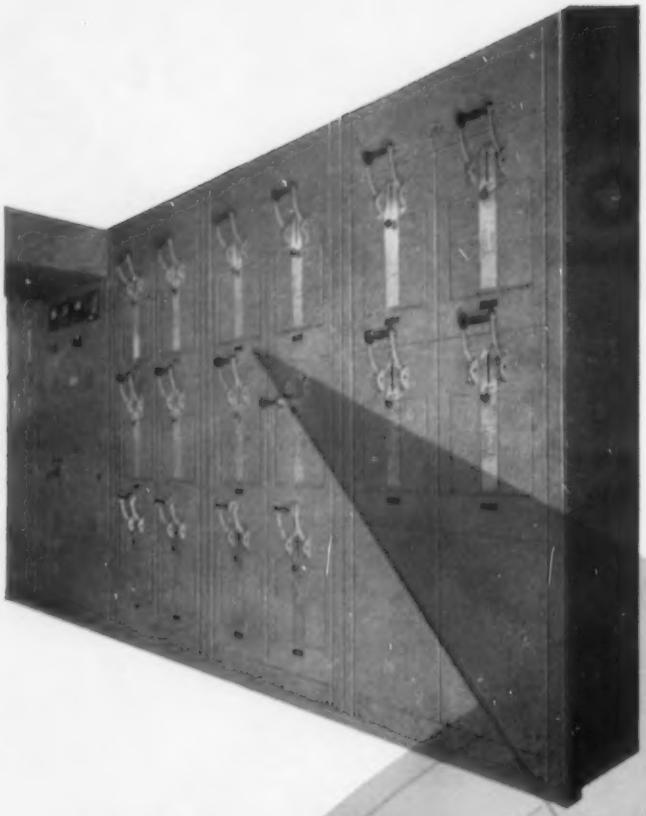
GALVA • ILLINOIS

Warehouse Stocks in Principal Cities for Immediate Delivery!



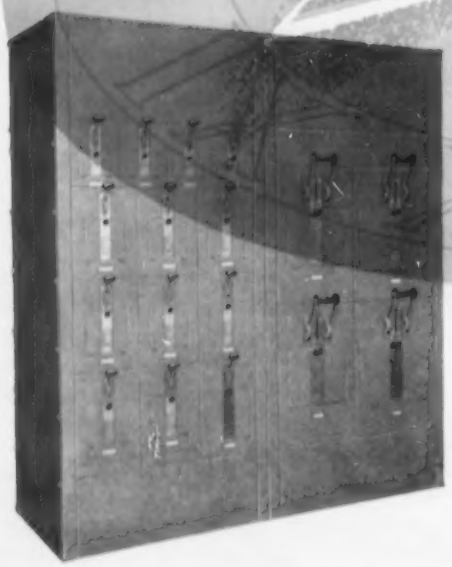
Include one of these safe, efficient and dependable FA switchboards in all your plans for new or modernized buildings.

Built of standardized pre-assembled units, incorporated in standardized enclosures, FA switchboards embody all the latest features in design and construction to assure the maximum in performance and operating efficiency and at substantial savings in maintenance costs.

Approved by the Underwriters' Laboratories' Incorporated for label service, all FA switchboards are factory-assembled, including bus bars, and are shipped ready for connection to main and branch cables. Units can be arranged singly or grouped, because all sections fit readily together. Removable end walls permit addition of sections on either side.

for long-lasting trouble-free service

For further information regarding these longer-lasting, trouble free switchboards contact your nearest FA Representative listed in Sweets. He will be glad to tell you more about them.



shutlbrak

A safety type switchboard designed for frequent and heavy duty. Features the FA shutlbrak switch, a horsepower-rated, front-operated heavy duty operating switch with quick make and quick break operation and interlocked fuse doors to permit access to fuse compartment only when switch is "off" (Special release provided for access in "on" position.) Heavily silver-plated copper contacts, new clamp type fuseholders and solderless connectors are other features.

Capacities: 30 to 1200 amps., 240 volts AC or DC and 600 volts AC 2, 3 and 4 poles. Rotary operating handles furnished on 30 to 200 amps. capacities. Straight handles on all others.

klampswitchfuz and snufarc

The klampswitchfuz or snufarc is a hinged type horsepower-rated operating switch unit that combines both disconnect switch and fuse protection into one unit, assuring years of trouble-free service. Heavily silver-plated copper contacts clamp fuses under pressure for low-resistance contacts. Access to fuses can be had only when door is open.

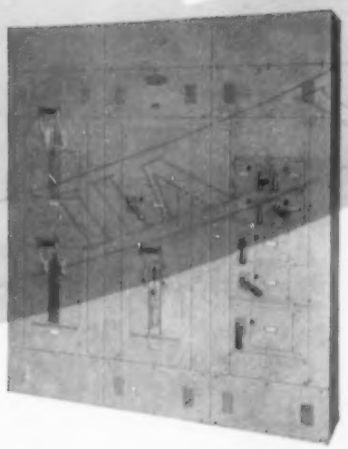
Klampswitchfuz, capacities 30 to 600 amps., 250 volts AC or DC 2, 3 and 4 poles, single or double throw. Snufarc ratings: 30 to 200 amps., 600 volts AC 2, 3 and 4 poles.

circuit breaker

A safety type switchboard that offers the latest developments in automatic protection of main and branch feeder circuits. Circuit breakers are thermal-magnetic trip, molded case type. Handle of breakers automatically moves to the "tripped" position on short circuits or dangerous overloads. After cause of trouble has been removed, handle can be restored to "on" position without inconvenience of replacing any part.

Capacities of circuit breakers 15 to 600 amps., 250 volts AC or DC and 600 volts AC 2 and 3 poles. Air circuit breakers are used on larger capacities.

choose FA SWITCHBOARDS



switchboard front connected

A unit type of switchboard for use where floor space is limited.

Like all FA switchboards, these boards are built of standard pre-assembled switching units that fit readily together to form one complete assembly. Designed for mounting against wall, they are constructed of standardized unit type sectional steel enclosures with integral pull boxes top and bottom. Switching units are either shutlbrak or klampswitchfuz plug-in design permitting ready interchangeability and replacement. Maximum feeder capacity 2000 amps., maximum branch circuits 1200 amps. 250 and 600 volts.

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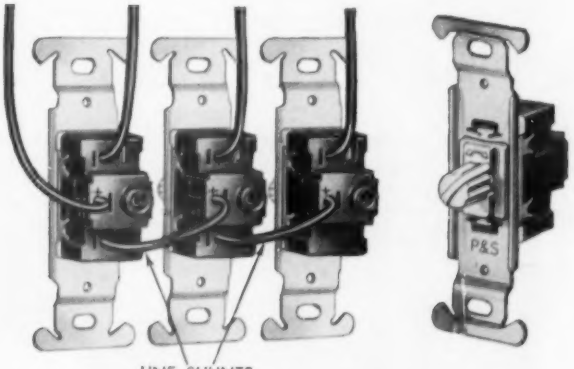
QUIET SWITCHES

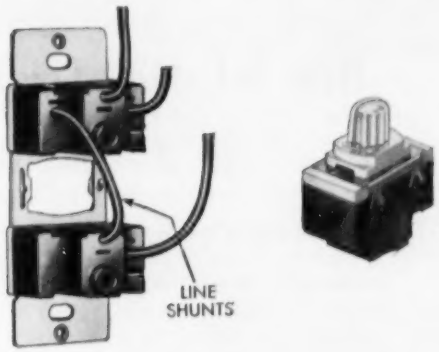
now available with LINE SHUNT

NO SOLDERING
NO SPLICING
NO TAPING
EASY TO INSTALL



P&S STRAP TYPE with LINE SHUNT
2591-I Ivory, Single Pole

ROTO-GLO switches with Line Shunt, simplify wiring when multiple switches are required . . . there is no soldering, splicing or taping required. By using ROTO-GLO switches for new and replacement work you are assured of getting the most advanced features in electrical switches today. ROTO-GLO gives you . . . the simple twist that turns lights on and off . . . the luminous knob that glows in the dark . . . and the clean functional design.



P&S DESPARD TYPE with LINE SHUNT
2581-I Ivory, Single Pole

The new roto-type switch mechanism and non-oxidizing silver alloy contacts are totally enclosed in a plastic body, assuring longer switch life and improved overall operation.

ROTO-GLO switches can be used to full current rating on incandescent and fluorescent lighting loads.

Write today for complete details to Dept. ECM-12.

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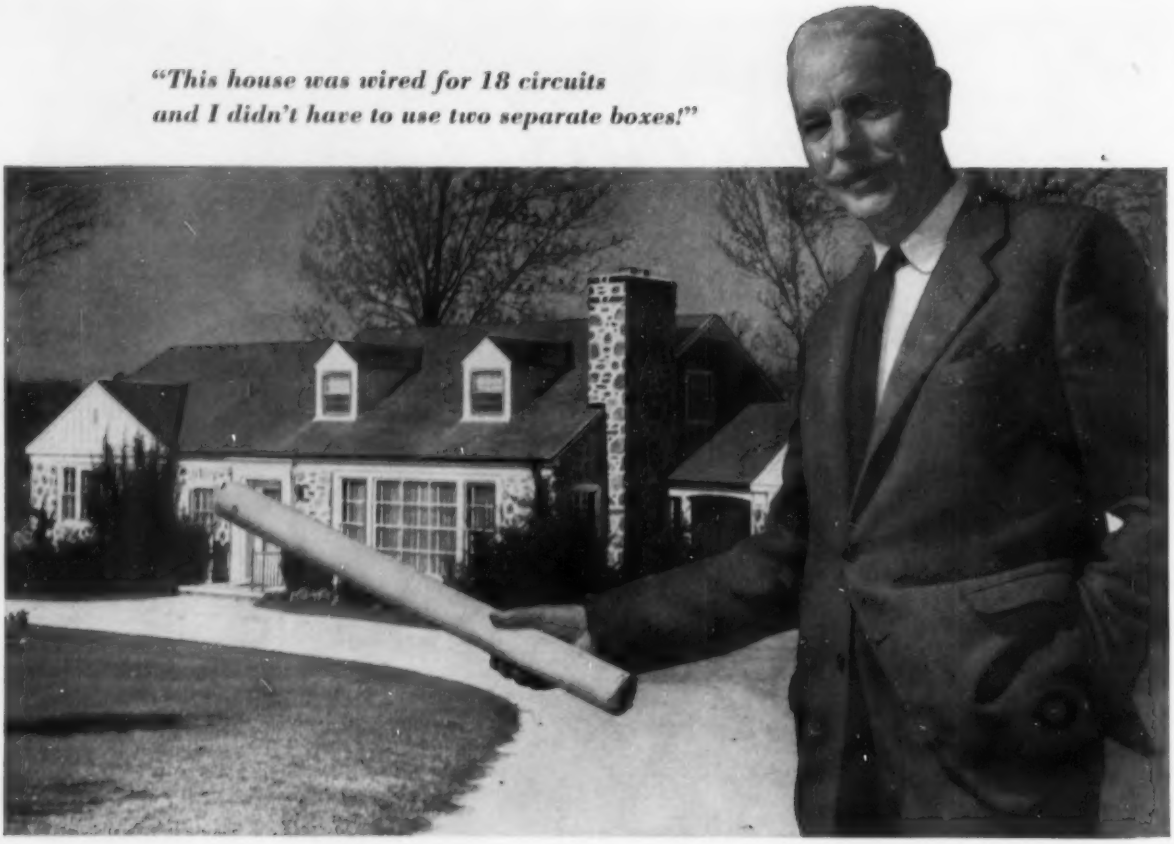
71 Murray St., New York 7, N. Y. 1229 W. Washington Blvd., Chicago 7, Ill.
In Canada: Renfrew Elec. & Refrig. Co., Ltd., Renfrew, Ontario

"This house was wired for 18 circuits and I didn't have to use two separate boxes!"



New G-E load centers handle up to 18 circuits in a "single package" installation

Each of General Electric's three new "package" load centers provide for 100 ampere, 3 wire service. You can use as many as 18 branch circuits, including five or more 240 volt two pole circuits. No separate disconnect is needed; the complete service entrance system is neatly and rapidly installed in just one box!*

Time saving features include: (1) Snap-in interiors—no screws to fuss with, plenty of working room. (2) Automatic two-way alignment of breakers and cover. (3) Straight-in wiring—no looping necessary, grips like a bear trap. (4) Silver plated copper for current-carrying parts—assures cool, long lasting performance. UL listed. See your G-E Trumbull distributor, or write Trumbull Components Dept., General Electric Company, 41 Woodford Ave., Plainville, Conn.

**In areas where local electrical code permits*

Three new G-E "package" load centers. Twenty-circuit unit, TRX2010S, has 5 double-pole, 8 single-pole circuits. Twelve-circuit load center, TRM1210S, has 100-amp main breaker wired in. Sixteen-circuit split bus unit, TRPX1610, has 3 double-pole, 8 single-pole circuits. All three permit wide variety of 120 and 240-volt combinations.

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GENERAL ELECTRIC

all set for high scores
in classes and sports with

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Boulder, Colo.

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(high bay and low bay)

CLASSROOMS: GuthLite, Jr.®

They wanted the best of everything for the students at Baseline Junior High. They chose Guth Lighting for every room from library to gym.
What a sight for young eyes!

Guth-Light helps make school days happy days—more "A's"—more baskets! Less fatigue from eyestrain—a brighter future with normal vision protected.

Study or play—it's all fun for the pupils at Baseline!

Write for detailed information on Guth School Lighting today.

Guth — Leaders in Lighting since 1902

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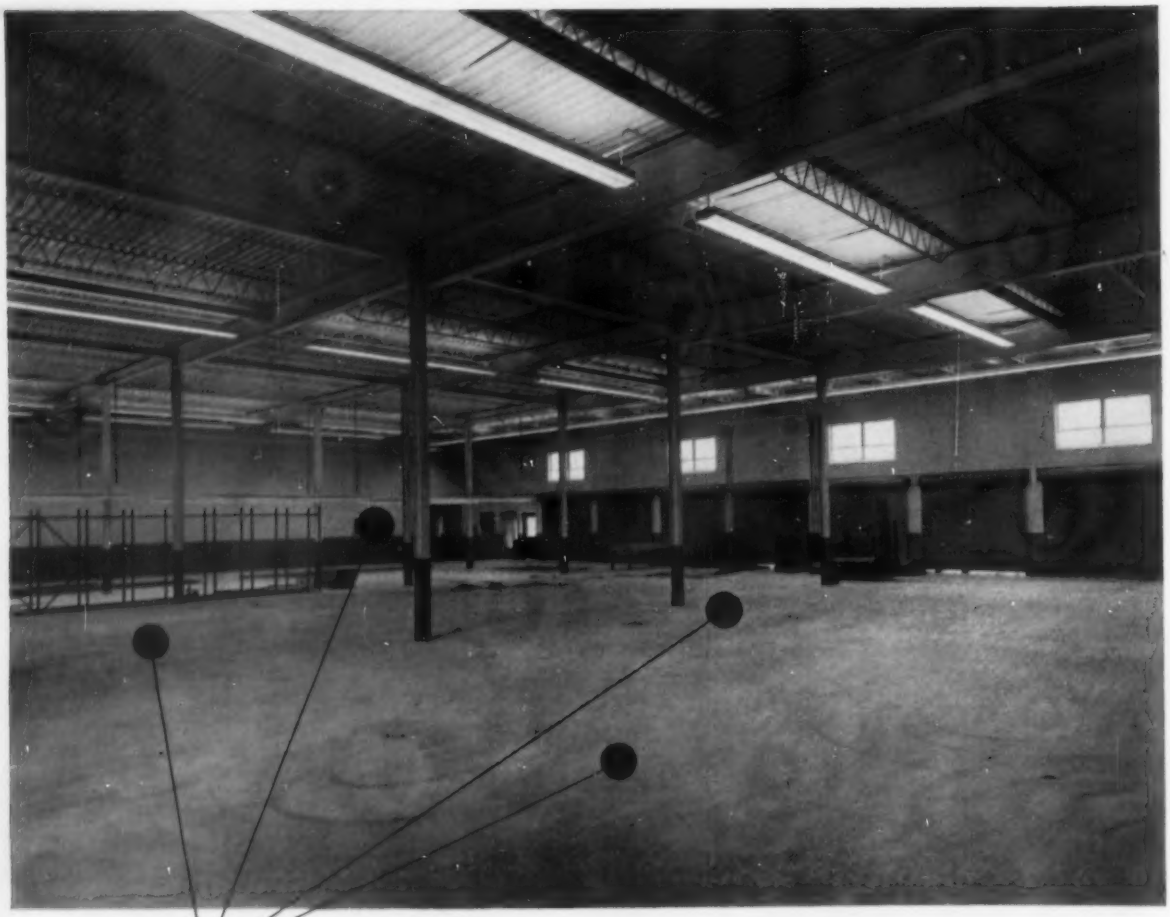

four areas here are custom lighted by **Litecontrol**

Variations in height and spacing of a single LITECONTROL fixture give each of the four working areas on this warehouse floor just the right light for its needs. Intensity is low in the heavy storage area (foreground), higher over the accessories racks (background). Other work areas, each custom lighted, are the assembly line (near the rear wall) and the loading area (by the doors).

Everywhere, the illumination is evenly distributed, easy on the eyes. The fixture used — LITECONTROL 2428 — is semi-direct, throwing almost 40% of its light upward to minimize harsh contrasts. Its efficiency is an unusually high 86%.

Installation and maintenance of LITECONTROL 2428 is easy because of its simple, two-piece, all-metal construction. Its smooth, curved surfaces wipe clean in seconds and encourage convection currents that have a self-cleaning action.

High efficiency, low brightness, ease of installation and maintenance, and versatility make LITECONTROL unbeatable for industrial lighting. Whether lighting or relighting, call on your local LITECONTROL representative.

INSTALLATION: Sun Oil Company, Dayton, Ohio

AREA: Warehouse

PROJECT ENGINEER: Alex M. Engart, Engineering Dept., Marketing Division, Sun Oil Company

ELEC. CONTRACTOR: Helldoerfer-Castellini, Dayton, Ohio

FIXTURES: Litecontrol No. 2428 2-lamp slimline industrial

MOUNTING HEIGHT: 17'-6" and 9'-0"

INTENSITIES: Over storage racks (foreground), 15 Footcandles in service — Accessories racks (low fixtures, background), 35 Footcandles in service — Motor Oil Assembly lines (background), 25 Footcandles in service — Loading area (near doors) 15-20 Footcandles in service

LITECONTROL *Fixtures*

LITECONTROL CORPORATION

36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

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In this revealing book, Century shows how and why the *New Standard*, smaller motors actually outperform the larger, heavier Old Standard models.

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Power cables are permanently protected by Youngstown Buckeye rigid steel conduit in this tunnel under the main floor of the new Administration Building at Cleveland (Ohio) Hopkins Airport.

65 tons of Youngstown Buckeye Conduit at Cleveland Airport

WHY YOUNGSTOWN BUCKEYE CONDUIT IS BETTER

Youngstown is the one manufacturer who makes rigid steel conduit from ore to finished product. This enables Youngstown to control the complete manufacturing process—your insurance that each length of "Buckeye" is made of top-grade steel.

Buried in these concrete floors and in tunnels—connected to pull boxes, base-plug boxes and lighting panels—are 65 tons of Youngstown Buckeye rigid steel conduit. "Buckeye" was specified for this Cleveland Hopkins Airport job because, above all, it's SAFE for critical wiring installations.

Youngstown

QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

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whatever the job . . .

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In our complete line, there's a self-sticking tape for every job . . . write Permacel Tape Corporation, New Brunswick, N. J.

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NEW Color-Coded T&B
Compression Connector
Cuts Lugging, Splicing Costs in half

Color-Coding of dies and connectors speeds Compression, assures Permanent joints

Long accepted as the best way to lug or splice conductors, T & B Method Compression Connectors are now available color coded.

A new tool, the TBM5 with color coded dies speeds compression time to give you lowest installed cost.

The connectors are available in one and two bolt hole lugs and two-way connectors from #8 to 1000MCM AWG. The TBM5 installs a wide range of conductors from #8 to 250MCM AWG.

HERE'S HOW THE TBM5 WORKS

Match color of die to color on connector

Compress with TBM5 Tool

That's all — lug is cold-flowed to a homogenous mass, joint is permanent

Here's what the new T & B Method means to you! First, only one tool is needed from #8 to 250MCM. Second, you get a permanent, high conductive joint every time, and, finally, your splicing and lugging operations are performed faster. Dies snap in, snap out, and the lightweight strong TBM5 is built for a life time of use.

300MCM to 1000MCM installs with compact 20-ton Hydraulic Tool.

Your T & B distributor has this complete line in stock. Be sure to ask for a demonstration. Write today for a compressed T&B connector, and ordering information.

THE THOMAS & BETTS CO.

INCORPORATED

34 Butler Street • Elizabeth 1, New Jersey

Thomas & Betts Ltd., Montreal, P.Q., Canada

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898 T62

Announcing **A NEW LINE OF**

R&S

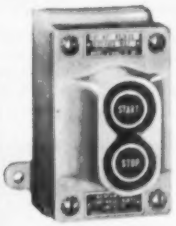
EXPLOSION-PROOF and DUST TIGHT

PUSH BUTTON and SELECTOR SWITCH STATIONS

EFS and HEFS TYPES

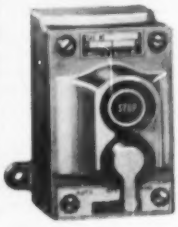
For Surface Mounting

(Class I, groups C & D)



EFS–213
HEFS–213

EFS–223
HEFS–223



EFS1S–W116
(Push button and selector switch)
HEFS–W11S
(Selector switch)

Two new product lines of Explosion-Proof and Dust Tight push button and selector switch stations are now available in surface mounting types for control circuits of 600 Volts A.C. maximum, for use in hazardous locations Class I, Groups C & D. Both Standard Duty (EFS) and Heavy Duty (HEPS) types are furnished in a variety of single and two element stations — single or double push button, single selector switch, or single push button and selector switch units as illustrated — offered in button operated or rocker arm actuated mechanisms. All interiors are interchangeable.

Russell & Stoll announces a new line of compact Standard Duty EFS and Heavy Duty HEFS push button and selector switch stations, designed to give long trouble-free service under severe operating conditions in hazardous locations • Standard Duty and Heavy Duty single and two element stations can be furnished in multi-gang or tandem units and in combination with other Russell & Stoll EFS devices • Both EFS and HEFS lines include stations with either push button operation or rocker arm control mechanisms—the rocker arm actuated types assure smooth, non-freezing operation under corrosive conditions.

Write for literature 2156-4

SPECIFY **R & S** EXPLOSION-PROOF EQUIPMENT — *A Complete Line...Your Complete Safeguard!*

Lighting Fixtures and Fittings • Boxes • Breathers and Drains • Swivel Type Fixture Fittings • U-Pul Connection Boxes • Delayed Action Plugs and Receptacles • Interlocked Switch Receptacles and Plugs • Circuit Breakers • Switches • Combination Starters • Magnetic Starters • Pilot Lights • Push Buttons • Receptacles and Circuit Breaker Combinations • Panelboards, Standard and Custom-built • Multi-Gang Control Stations, all types.

RUSSELL & STOLL COMPANY, INC. • 125 BARCLAY STREET, NEW YORK 7, N.Y.

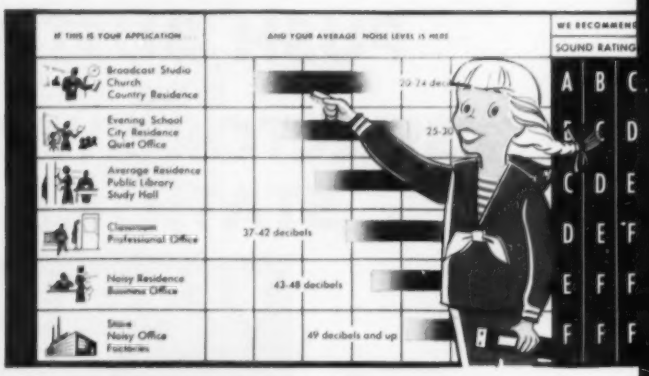
D21

RUSSELL & STOLL

PRECISION-BUILT ELECTRICAL EQUIPMENT — SINCE 1902

Flora shows you*

General Electric



1. SOUND RATING—Only G-E ballasts are sound-rated to assure you of meeting your sound level requirements. You can choose the proper G-E ballast whether it's for a quiet installation or for an application where noise is less important. G-E sound rating eliminates expensive noise complaints.

4. LAMP-MATCHED DESIGN—The ballast governs light output and life of the fluorescent lamp. G-E ballasts are lamp-matched to provide up to 50% longer lamp life and up to 30% more light output. Here you save two ways—lower lamp replacement costs and more light from your installation.

Whether you use, install, specify or make fluorescent fixtures, G-E ballasts mean savings to you!

The six reasons why you save, described by Flora above, grow out of these simple facts:

- **G-E ballasts are designed to high engineering standards (1, 3, 4, 5 above).**
- **G-E ballasts are made under exacting quality control standards (2 above).**
- **G-E ballasts are backed by complete sales and engineering services (6 above).**

Only G.E. offers you all these money saving features.

In every conceivable way, we make sure you get more when you use G-E ballasts. For example, G-E engineering standards

Copyright 1954, General Electric Company.

Core and coil construction is carefully designed for minimum power loss; close control of noise and heating. Quality insulation throughout—protects against failure, assures longer life.

All components, like this G-E Pyranol† capacitor, are manufactured to our precise specifications.

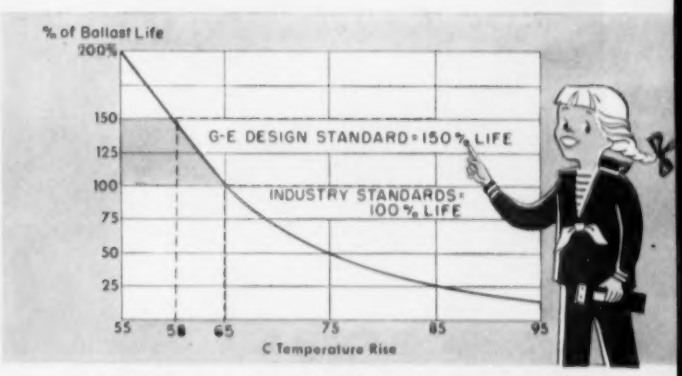
†*Reg. trade mark of General Electric Co.*

Every part of a G-E ballast is carefully designed, manufactured, tested and assembled to give you the best ballast value.

six ways . . .

ballasts help you save lighting dollars

2. UNIFORMLY HIGH QUALITY—Lighting specifiers have learned to depend upon the consistently high quality of G-E ballasts. Rigid material specifications and constant production line tests mean uniformly good ballasts; save lighting dollars on early replacement and maintenance costs.



3. LONGER LIFE—G-E ballasts are designed to operate 10% cooler than U.L. and Certified Ballast Manufacturers' standards. Tests show that a 10% reduction in ballast temperature rise can mean up to 50% longer ballast life, giving you half again as much ballast life!

5. PROVED PRODUCT LEADERSHIP—General Electric has the largest group of specially trained ballast design and development engineers in the industry. They're constantly improving G-E ballasts, assuring you of all benefits of top quality when you "specify" General Electric.

6. COMPLETE CUSTOMER SERVICES—General Electric's extensive sales, warehousing, and engineering organization is anxious to serve you. These unequalled facilities can provide services for you which no other ballast manufacturer offers. These extra services mean real saving to you.

actually exceed the specifications established by the Certified Ballast Manufacturers where extra quality pays off to you. Another example: Ten quality control stations make dozens of physical and electrical checks during manufacture to assure that each ballast measures up to the high G-E standards.

Next time, specify General Electric Ballasts. Dollar for dollar they're your best ballast value.

LOOK FOR THIS G-E BALLAST TAG →

A G-E ballast tag on your fixture is proof that it's equipped with a top-quality ballast. It's the easy way to be certain. For further information on G-E ballasts, contact your nearest G-E Apparatus Sales Office or G-E Distributor. General Electric Company, Schenectady 5, New York. 401-7

***Miss Flora Ballast, G-E Ballast Mascot.**

Progress Is Our Most Important Product

GENERAL ELECTRIC

Several sales from one call with Exide Lightguard®

When lights go out, Exide Lightguards go on instantly and automatically . . . they protect your customers against panic, looting, injury and other perils that breed in the dark. No fuss, no bother—just plug into any 115 volt outlet and it's in business. Compact Lightguards are designed and built with the dependable quality of Exide. UL-approved, they require a minimum of maintenance because the long-life Exide Storage Battery is kept charged with a 2-rate charger —high rate or trickle.

Don't delay, send in this coupon today!

EXIDE Industrial Division
The Electric Storage Battery Company, Philadelphia 2, Pa.
Rush details on the portable Exide Lightguards.

Name.....

Address.....

City.....Zone.....State.....

My business is: ☐ Electrical Contractor ☐ Consulting Engineer

☐ Architect ☐ Distributor ☐ Dealer ☐ Electrical Engineer

☐ Other.....(fill in)

16

Emergency Lighting Equipment

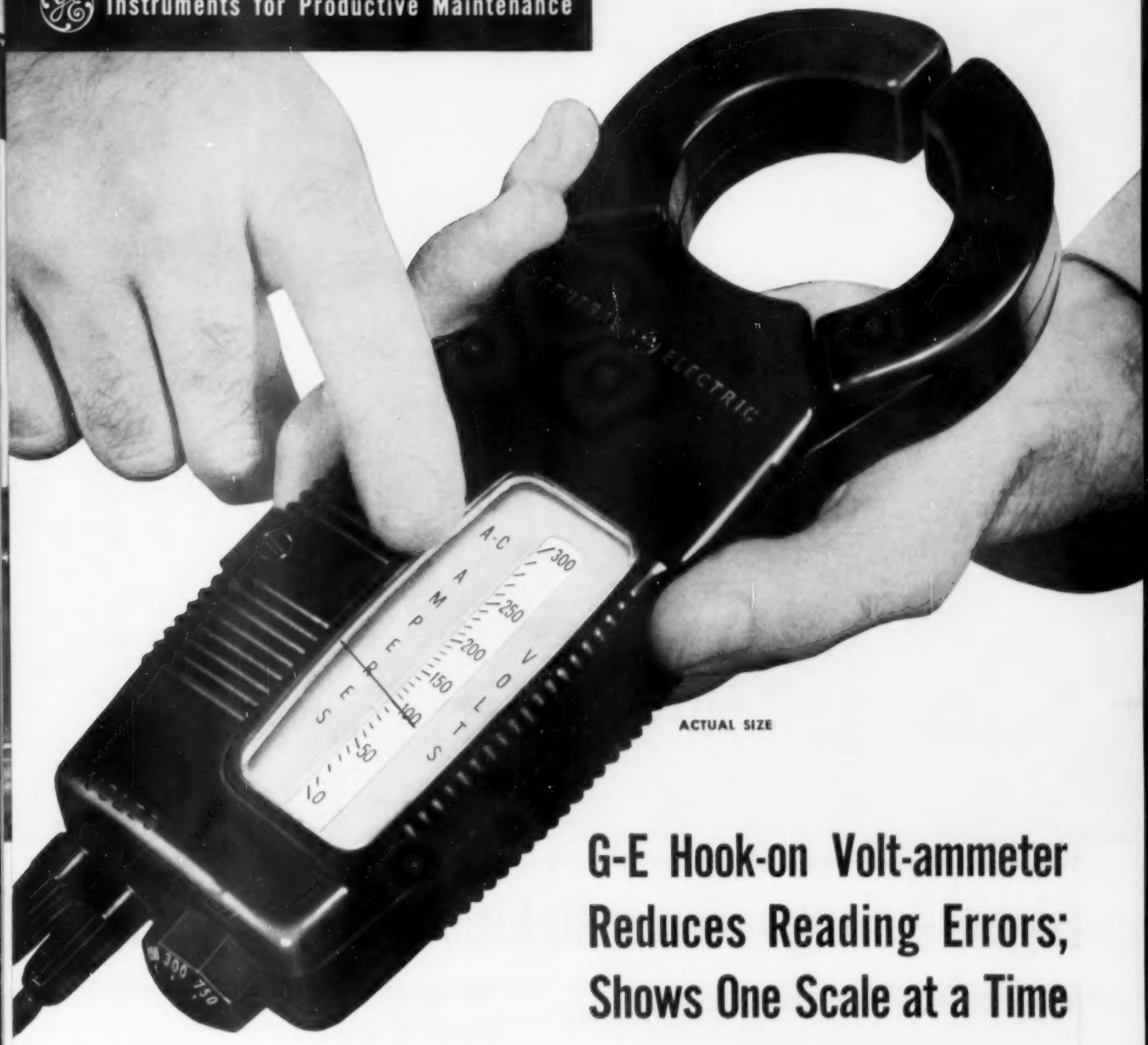
When you sell Exide Lightguards, you don't stop with one, you usually sell several. The profit you make per unit is high. But the potential for many sales is the attraction. Auditoriums, corridors, locker rooms, gymnasiums, stairways, laboratories—any place where people collect—have need of several emergency lighting units. Some industrial plants require as many as 200.

This is a rapidly expanding market—every day, more and more people are becoming safety conscious. They need Lightguards, you sell them. It's as simple as that. There are hundreds of profit-making spots in your community—schools, offices, factories, stores, hotels, banks, hospitals, restaurants.

Build extra profits for yourself fast by cashing in as an Exide Lightguard dealer.

Exide®
INDUSTRIAL DIVISION
The Electric Storage Battery Company
Philadelphia 2, Pa.

Instruments for Productive Maintenance



ACTUAL SIZE

G-E Hook-on Volt-ammeter Reduces Reading Errors; Shows One Scale at a Time

GENERAL ELECTRIC'S hook-on volt-ammeter shows only one scale at a time. You simply select the desired range and only the corresponding scale is visible. This eliminates the possibility of reading the wrong scale, as can be done with multiple scale face instruments. The range and scale of this G-E instrument are changed simultaneously by turning the finger-tip control knob. The two models of the instrument are designated Types AK-4 and AK-5, and both have current scales marked in black and voltage scales marked in red.

USED BY contractors, electricians, engineers, maintenance and servicemen, the G-E hook-on is ideal for balancing circuits and tracing faults and grounds without shutting down equipment.

WIDE RANGES are available in both models of the G-E volt-ammeter. Ranges of the AK-4 model are 0-10/30/-100/300/800 amperes and 0-150/300/750 volts. The AK-5 ranges are 0-5/20/80/350 amperes and 0-150/-300/750 volts. The wider range AK-4 model has a pointer-stop to check surge readings.

FOR FURTHER INFORMATION, write section 582-10, General Electric Co., Schenectady 5, New York and ask for bulletin GEA-6292, or contact your nearest G-E Apparatus Sales Office.

Progress Is Our Most Important Product

GENERAL ELECTRIC

POWER DISTRIBUTION

Long electrical feeders were needed to serve building's rambling wings and 11-story tower, thus making higher-voltage system ideal.

Higher-voltage General Electric distribution

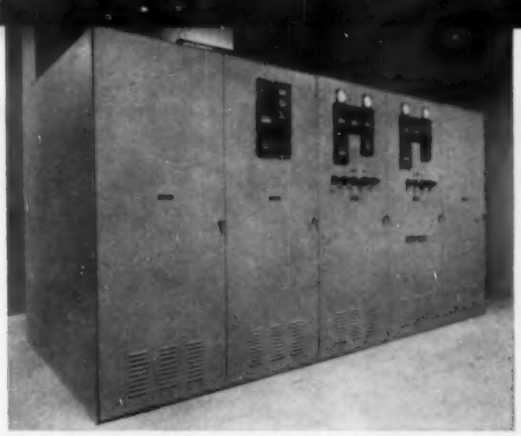
Planners use 480Y/277-volt savings to provide liberal capacity for future loads

Featuring high-level lighting, year-round air conditioning, banks of business machines, escalators, and elevators, the new North Central Home Office Building of the Prudential Insurance Co. has an average of almost 10 volt-amps of electrical load for each of 292,000 square feet of floor space. In spite of this dense load, Prudential was able to save money on the vital power distribution system serving its Minneapolis building.

G-E ENGINEERING SERVICE helped throughout the building project, from early planning to start-up. Here, G-E sales engineer, G.E. Troyak (standing) confers with J. F. Hegberg, assistant manager—building service; N. K. Knafla, chief electrical engineer of Magney Tusler & Setter, architects and engineers; and A. S. Ingebredtsen of Electric Repair & Construction Co., electrical contractors.

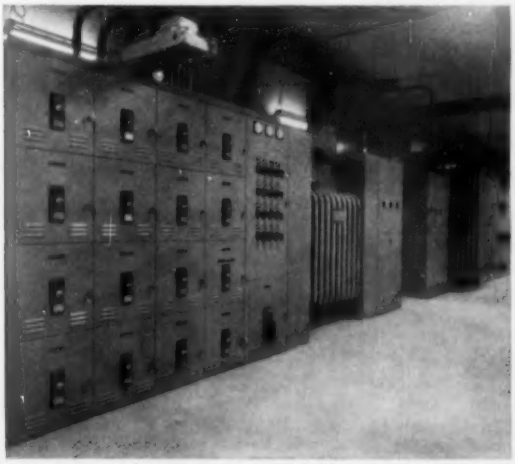
SAVING WAS MADE POSSIBLE by using a 480Y/277-volt distribution system to serve most of load. It would have cost about $50,000 more for a comparable system with 120/208Y volts. The present system has liberal capacity already designed-in to accommodate future increases in electrical demand. Also, to assure reliability, it has two primary power sources, with equipment to switch automatically from one to the other in emergencies.

Key to economies of this system is that the higher the secondary voltage, the lower the current for a



SYSTEM PROTECTION and control at dual 13.8-kv service entrance is provided by highly reliable G-E metal-clad switchgear. Equipment automatically switches load from one line to the other in case of power failure.

EXTRA RELIABILITY of double-ended G-E substation supplying 480Y/277 volts helps assure power continuity. Either transformer can maintain all vital building services.



NECESSARY 120-V POWER for incandescent lights, and business machines is supplied by compact G-E unit substation with electrically operated circuit breakers. Draw-out breakers facilitate cleaning and inspection of units.

WELL-LIGHTED offices use standard General Electric fluorescent lamps with G-E 265-v ballasts operating off 277-v circuits to maintain design illumination of 40 foot-candles.

system saves Prudential estimated $50,000

given kva load. Lower current-carrying requirements mean conductors, such as cable and bus, can be smaller or fewer in number, and circuit breakers can handle higher loads. Other savings come from 440-v motors and control, and reduced voltage drop.

THREE CRITERIA governing applicability of 480-volt system to specific buildings are: (1) load make-up—at least one third of load must use 480 or 277 volts; (2) load magnitude—total load must be at least 200 kva with primary service, 1000 kva when served from secondary network; (3) length of risers and feeders—if these average 200 feet, system will be economical regardless of (1) above.

This system can pay off for you too, and so can General Electric engineering assistance available to you with General Electric equipment. Contact your nearest G-E Apparatus Sales Office for full details or mail coupon at right. General Electric Co., Schenectady 5, N. Y.

JUST RELEASED: A More Power to America film program on power distribution for commercial buildings. Featuring an informative full-color film, "The Tenant at 1010 Main," the program portrays the benefits of an adequate system and 480-volt distribution. Ask your G-E Representative about it or mail coupon.

Engineered Electrical Systems for Commercial Buildings

GENERAL ELECTRIC

FOR MORE INFORMATION

MAIL COUPON TODAY

GENERAL ELECTRIC CO.
SECTION B 680-3
SCHENECTADY 5, N. Y.

Please send me:

☐ "Modern 480Y/277-volt Power Distribution Planning Guide" (GEA-6344)

☐ "Modern Distribution Equipment for Commercial Buildings in Secondary Network Areas" (GEA-6223)

I am also interested in ☐ borrowing, ☐ purchasing "The Tenant at 1010 Main," 33-minute, color, motion picture.

NAME .....

POSITION ..... COMPANY .....

ADDRESS .....

CITY ..... STATE .....

G-E MANUAL STARTERS . . .

INTEGRAL-HORSEPOWER manual starter used to control a grinder. For dependable protection, toggle-switch and push-button forms give visible indication of overload and are trip-free.

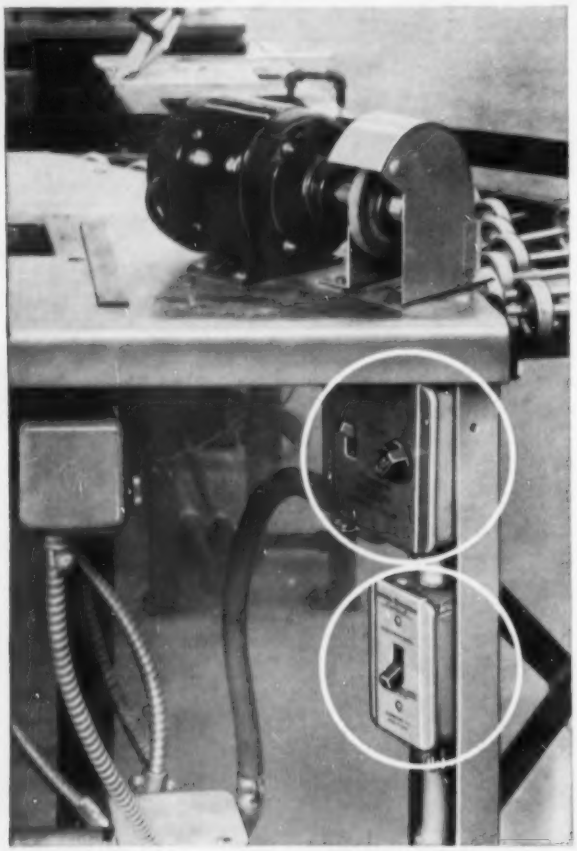
When you need low-cost motor control for motors up to 7½ horsepower, be sure to specify General Electric manual starters. Economical to buy, G-E manual starters reduce installation time and lower your installation costs.

EASY MOUNTING is one of the installation features of manual starters. The CR1061 fractional-horsepower starter can be mounted on or beside the machine, and no accessories are required. A maximum of four screws are required to mount the starter.

Toggle-operated

Pushbutton-operated

INTEGRAL-HORSEPOWER STARTERS



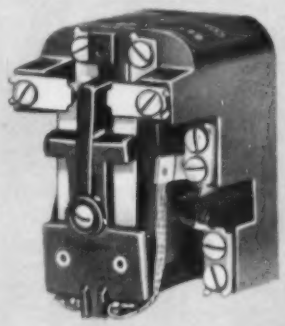
SPECIAL COMBINATIONS of fractional-horsepower starters provide a wide selection for your applications. Here two forms of the CR1061 are used in a heating and grinding application.

VERSATILE G-E RELAYS

The small, general-purpose relay, CR2790, is adaptable to applications with a maximum of four circuits. It can be used for lighting and air conditioning loads, as a control relay, and as a fractional-horsepower motor starter for small pumps and fans if overload protection is provided elsewhere.

A flexible shunt withstands vibration and adds to long relay life. Silver contacts provide dependable make-and-break. Relay accessories provide for back-mounting, plug-in operation, and for use in dusty and hazardous locations.

For more information on the general-purpose relay, write for bulletin GEC-257.



General-purpose Relay

Economical to Buy-Faster to Install

The CR1062 starter for integral-horsepower motors up to 7½ horsepower is also easily mounted. There is a keyhole slot at the top of the enclosure, which supports the starter while the two bottom screws are inserted and tightened.

WIRING IS SIMPLIFIED in all G-E manual starters. Knockouts on the top, bottom and sides allow the best wiring arrangement for the application. Large easily reached terminals simplify the wiring, which is all connected from the front. Front connection is especially valuable when you want to mount starters side by side to save space.

YOUR CUSTOMERS will also like the General Electric manual starters. All starters have silver contacts, quick breaking switch mechanisms, and bi-metallic overload relays, for long dependable operation. For more information on manual starters, write for bulletin GEA-6358.

Toggle-operated

Starter and Selector Switch

Starter and Indicating Light

Two Starters

FRACTIONAL-HORSEPOWER STARTERS

MEAN OFF-THE-SHELF SERVICE

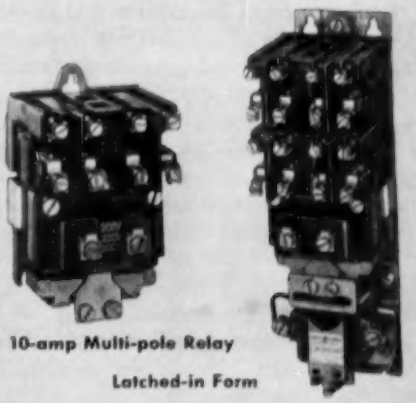
Versatile G-E 10-amp multi-pole relays give you off-the-shelf service for many applications. Relay forms available include two through eight poles. Contacts change from normally open to normally closed without any tools or additional parts.

FRONT-MOUNTED, sturdy terminals are easily accessible for front wiring, even when the device is mounted in an enclosure.

Another form of the relay includes a latched-in mechanism for maintaining sequence continuity in the event of power failure, or where extremely quiet operation is required.

A modification kit is available to convert a 10-amp multi-pole relay to a latched-in relay. All parts are included in the kit, and are easily added to the bottom of the relay with a screwdriver.

For more information on the latched-in form, write for bulletin GEC-1281.



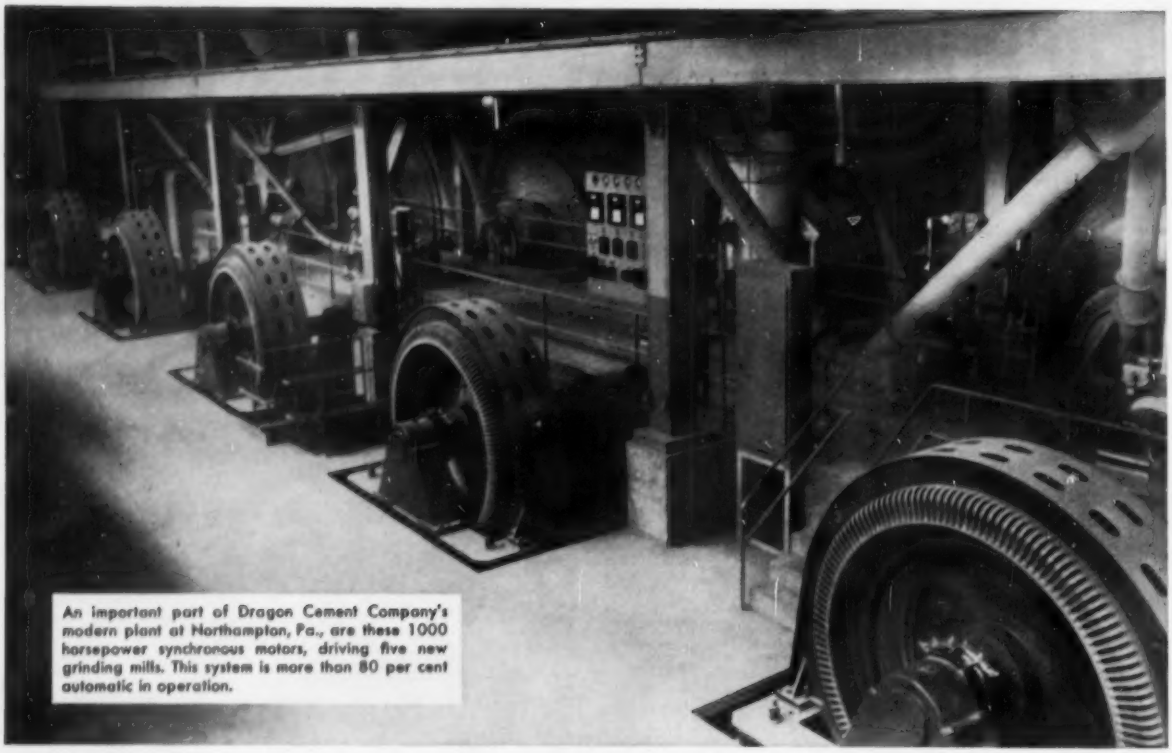
10-amp Multi-pole Relay

Latched-in Form

For further information, contact your G-E Apparatus Distributor, or write Section 733-6.

GENERAL ELECTRIC

BLOOMINGTON, ILLINOIS



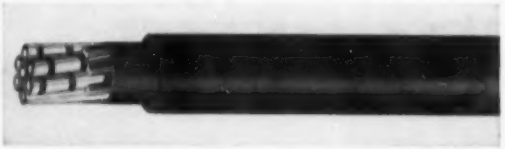
An important part of Dragon Cement Company's modern plant at Northampton, Pa., are these 1000 horsepower synchronous motors, driving five new grinding mills. This system is more than 80 per cent automatic in operation.

80% automatic, this plant specified OKOLITE-OKOPRENE cables

Since Dragon Cement Company's new mill was to represent the latest developments in cement making techniques, process control and automation were given the greatest consideration. This necessitated a reliable electrical power distribution system with dependable control circuits.

After thoroughly investigating the neoprene-jacketed wire field, they selected Okolite-Okoprene. In their new mill installation, 70 miles of cable were used for control circuits, and 25 miles for power distribution—all Okolite-Okoprene.

Dragon Cement Company is following a nation-wide trend of manufacturers to Okolite-Okoprene cables for circuits that must not fail. Okolite oil-base insulation, made from natural wild up-river Fine Para rubber, is moisture-, ozone-, and heat-resistant. The Okoprene sheath gives maximum protection from most harmful acids, oils and chemicals. In addition, because Okoprene's high surface resistivity prevents heavy longitudinal drainage currents, these cables are used in many



utility and industrial plants *unshielded* up to 5000 volts. When you order cable for circuits that must not fail, specify Okolite-Okoprene. Write for our new Bulletin EC-1085 for full details. The Okonite Company, Passaic, N. J.

OKONITE SINCE 1878 *insulated cables*

2967

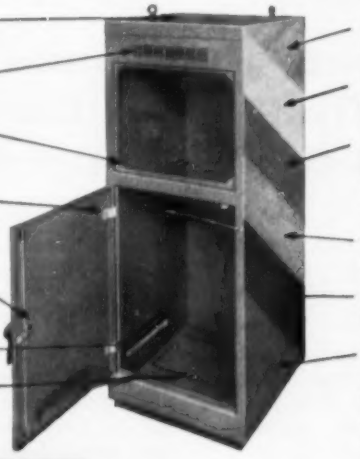
Does your maintenance crew spend Sundays servicing metalclad switchgear?

WHEN HIGH VOLTAGE switchgear gets rusty, power must be cut off for repairs and repainting. That means service work must be done on overtime, when the plant is not operating.

S&C believes that metalclad switchgear should be out of sight and out of mind—except on those rare occasions when it operates as a protective device, or when switching is necessary. The extent to which S&C goes to prevent rust and avoid switchgear maintenance is illustrated below. Only a detail? Perhaps . . . but a mighty BIG detail when less careful engineering can cause avoidable service work.

Here Is WHY S&C Metalclad Switchgear Resists Rust and Reduces Maintenance Costs

- Inside of top is coated with Insulmat ® to prevent condensation.
- Louvers are placed to provide free air circulation.
- Before welding, lapped and butted surfaces are zinc coated, eliminating bare surfaces which might rust.
- Hinges and edges, as well as bolt and latch holes, are zinc coated to assure protection of hidden surfaces.
- Hinge pins are stainless steel. Hinges, door locks, and other ferrous working parts are galvanized.
- Strip heaters prevent condensation.
- Underneath, surfaces are coated with water-repellent Texacote® to provide protection against ground moisture.



- Cold-rolled steel makes a scale-free, oxide-free base.
- All welds and sharp edges are ground smooth.
- Surfaces are thoroughly phosphatized to remove grease and provide a neutral, rust-resistant surface that assures good bonding.
- Zinc coating prevents rust from spreading in case surface is scratched.
- To make a good bond, zinc chromate is used for the prime coat.
- Finish coat is a new melamine-alkyd-urea synthetic applied by the hot-spray method and oven-baked at 375°. It has a thickness equal to four coats of conventional enamel or lacquer.

Specialists in High-Voltage Switchgear for Electric Utilities since 1910

S&C ELECTRIC COMPANY

4433 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U.S.A.

Consult your telephone directory. Sales offices in Birmingham, Boston, Buffalo, Chicago, St. Louis, Cleveland, Dallas, Dearborn, Denver, Houston, Huntington, Indianapolis, Jersey City, Kansas City, Little Rock, Memphis, Minneapolis, New Orleans, Philadelphia, Pittsburgh, Portland (Ore.), St. Petersburg, Salt Lake City, San Francisco, San Gabriel (Los Angeles), Seattle, Syracuse, Washington, D. C. In Canada: S&C Electric Canada, Ltd., 8 Vanco Road, Toronto 14, Ontario.

COMFORTABLE, GLARE-FREE ILLUMINATION for the Great Lincoln Shopping Center is provided by this Sola-ballasted, high-intensity fluorescent lighting installation. Each luminaire houses two F100T12 lamps operating from an outdoor, high-output Sola Fluorescent Ballast. Consulting Engineer is Peter W. Bruder; luminaires and standards are by Pfaff & Kendall.

Sola-Ballasted, Fluorescent Lighting Builds Traffic and Business in Great Lincoln Shopping Center

The Great Lincoln Shopping Center, Oceanside, N. Y., illustrates the importance of adequate parking lot lighting. Here, safety and convenience for nighttime shoppers, through high-intensity fluorescent lighting, result in profitable traffic for merchants.

The heart of this installation — maintaining dependable lumen output — is the new outdoor, high-output Sola Fluorescent Ballast. These two-lamp Sola units are helping to reduce operating and maintenance costs to a minimum, too.

Premium performance, at no additional cost, is available when you specify Sola Fluorescent Ballasts for high-intensity lighting applications — street lighting, parking lots, playfields, gasoline stations, and commercial and industrial installations.

If you're concerned with the manufacture, design, operation or maintenance of fluorescent lighting installations, investigate the advantages of Sola Fluorescent Ballasts. Write for the full facts or request a call from your Sola sales engineer.

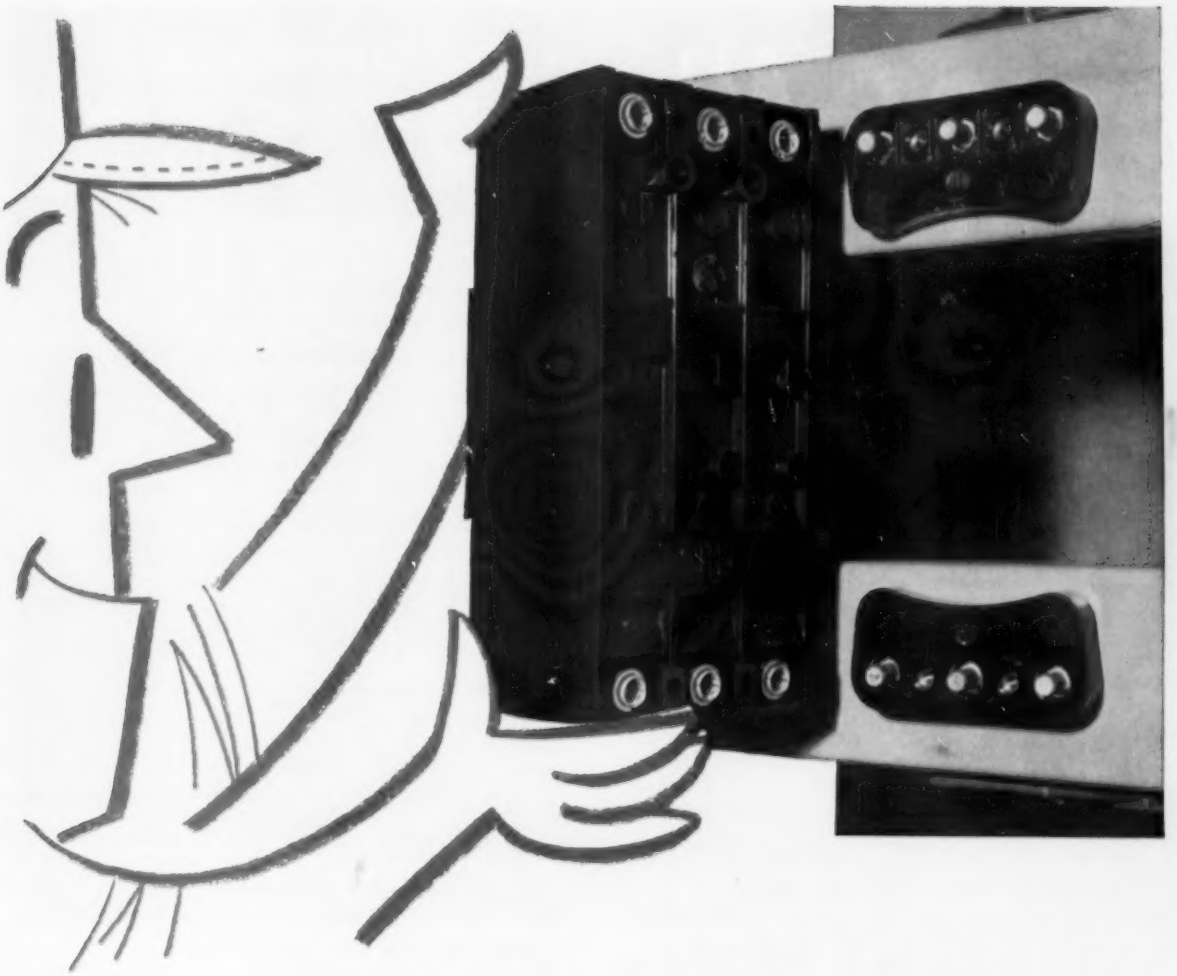
SOLA *Fluorescent* **BALLASTS**

Write for Bulletin 17C-FL-196A.

SOLA ELECTRIC CO., 4633 W. 16th St.

CHICAGO 50, ILLINOIS

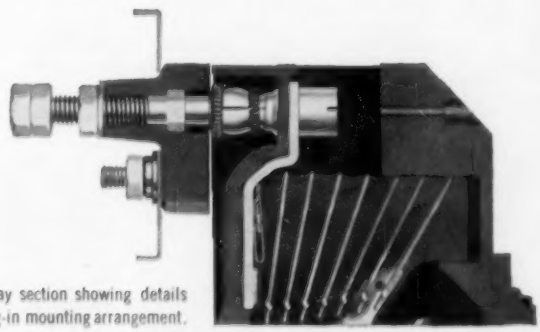
CONSTANT VOLTAGE TRANSFORMERS for Regulation of Electronic and Electrical Equipment • **LIGHTING TRANSFORMERS** for All Types of Fluorescent and Mercury Vapor Lamps. • **SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414** • *NEW YORK 35: 103 E. 125th St., TRafalgar 6-6464* • *PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988* • *BOSTON: 272 Centre Street, Newton 58, Mass., Bigelow 4-3354* • *CLEVELAND 15: 1836 Euclid Ave., PRospect 1-6400* • *KANSAS CITY 2, MO.: 406 W. 34th St., Jefferson 4382* • *LOS ANGELES 23: 3138 E. Olympic Blvd., ANgelus 9-9431* • *TORONTO 17, ONTARIO: 102 Laird Drive, Mayfair 4554* • *Representatives in Other Principal Cities*



Ordering Switchboards? Specify Plug-In Mounting of Molded Case Circuit Breakers

Consider the advantages of I-T-E Plug-In Mounting. The added safety of concealed breaker terminals with no live parts exposed. The flexibility of changing breaker ratings within a frame size. The ease of installation and removal. When you do, you'll specify switchboards with this time-proved method of installing molded case circuit breakers—used for many years in maritime switchgear and approved by Underwriters Laboratories Inc.

I-T-E plug-in molded case circuit breakers are available in ratings from 15 to 600 amp, up to 600 volts a-c, 250 volts d-c. Contact your I-T-E representative or leading independent switchboard manufacturers for details. Or write Small Air Circuit Breaker Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Phila. 30, Pa.



Cutaway section showing details of plug-in mounting arrangement.

I-T-E CIRCUIT BREAKER COMPANY

Small Air Circuit Breaker Division

NOT ALL

DRY-TYPE TRANSFORMERS ARE UNDERWRITERS' APPROVED NOR ARE THEY ALL ALIKE

Check the Underwriters' Laboratories list of approved transformers

- ***Less than One-Half are Approved***

The few makes which are on the "Underwriters' Laboratories" list, include SORGEL air-cooled transformers, both single phase and 3-phase, which have been tested and approved under the "Reexamination Service" for more than 25 years. Only one other manufacturer of 3-phase units is on that list.

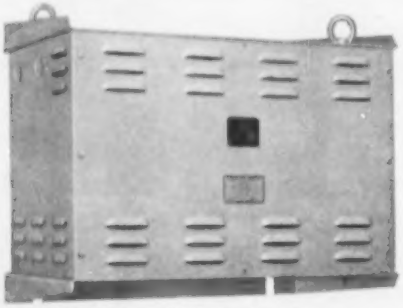
All SORGEL transformers are constructed according to the latest Underwriters' Laboratories standards. They also meet all the requirements of the ASA, AIEE, and NEMA standards.

- ***Not Just an Ordinary Transformer***

SORGEL dry-type transformers are not just ordinary transformers that were converted to follow the trend toward air-cooled transformers. SORGEL dry-type transformers are designed and constructed especially for indoor installations close to load centers.

COMPLETE LINE

¼ Kva to 2500 Kva, single phase.
1 Kva to 3000 Kva, 3-phase, 2-phase and phase changing.
All standard voltages, such as 120, 208, 240, 480, 600, 2400, 4160, 4800, 7200, 13,200, up to 15,000 volts, and any intermediate or special lower voltages.



15 to 50 Kva 3-phase. Wall mounting type

¼ Kva single phase 480/240 to 240/120 volts

SORGEL transformers, by tests, comparisons and experiences, proved to be the best.

That there is a difference in dry-type transformers was revealed in the findings of a survey made by Plant Engineering, a trade publication, which mailed 500 questionnaires to users of air-cooled transformers. (A copy of this survey report will be sent on request.)

- ***Liberal Design for Full Rated Load***

SORGEL air-cooled transformers are guaranteed to carry the full rated load continuously at a safe, low operating temperature, and are so liberally designed that they can safely carry an overload during an emergency.

- ***Quiet operation***

The sound level is well below the established standards. Because of their quiet operation, SORGEL transformers are particularly adaptable for indoor installations close to load centers, and where low sound levels are an important factor.

- ***Long Life***

Thermo-vacuum impregnated windings are brazed to terminals.

- ***Easy and Low Cost Installation***

All self-contained in a single unit, either single or 3-phase, with simple connections to make. No separate mounting brackets to make or buy. Substantial wall brackets or floor mounting base are an integral part of SORGEL transformers. Equipped with solderless terminal lugs.

- ***Rugged Construction***

All fabricated steel frames and enclosures. No castings or flimsy enclosures that might be broken or damaged during shipping or handling.

SORGEL TRANSFORMERS

Stock carried by jobbers in the following cities:

New York, N. Y.	Cincinnati, Ohio	Louisville, Ky.
Buffalo, N. Y.	Cleveland, Ohio	Cedar Rapids, Iowa
Roxbury, Mass.	Chicago, Ill.	Davenport, Iowa
High Point, N. C.	Rockford, Ill.	Omaha, Neb.
Raleigh, N. C.	Rock Island, Ill.	Beaumont, Texas
Philadelphia, Pa.	Richmond, Ind.	Los Angeles, Calif.

Consult the classified section of your phone directory or write to factory

SORGEL ELECTRIC CO., 836 West National Ave., Milwaukee 4, Wisconsin

Sales Engineers in Principal Cities

New high school for a southern city...

WIRE BY PHELPS DODGE

This modern new Senior High School in Gainesville, Fla., one of the finest in the state, is smartly designed to handle both present and future student enrollment needs. One-third more students can be accommodated merely by adding extra classrooms to the present structure. The school's auditorium, gymnasium and cafeteria were constructed to provide for this future expansion of the student body.

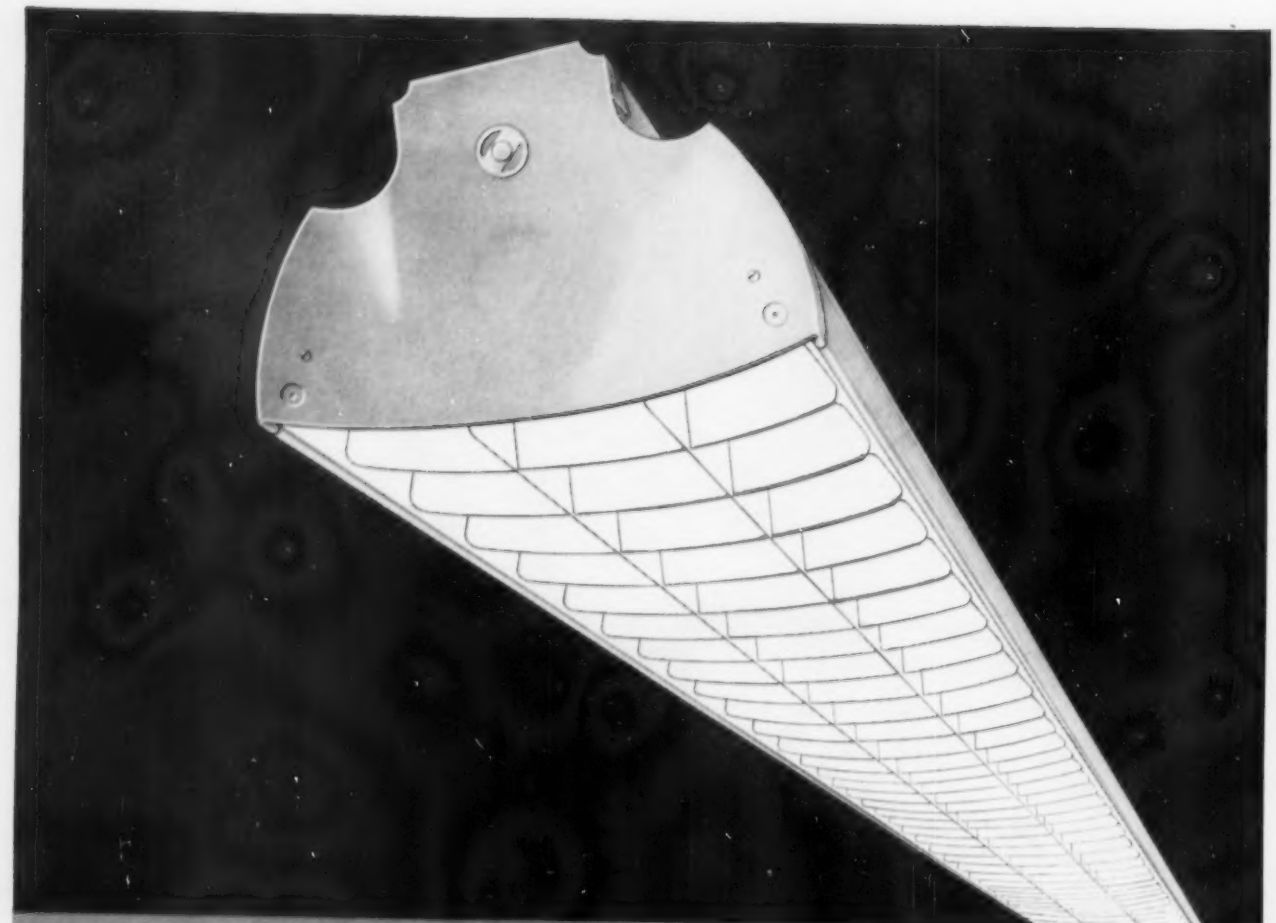
To assure dependable, trouble-free electrical service at all times, Phelps Dodge wire and cable was specified and installed throughout this distinctive school.

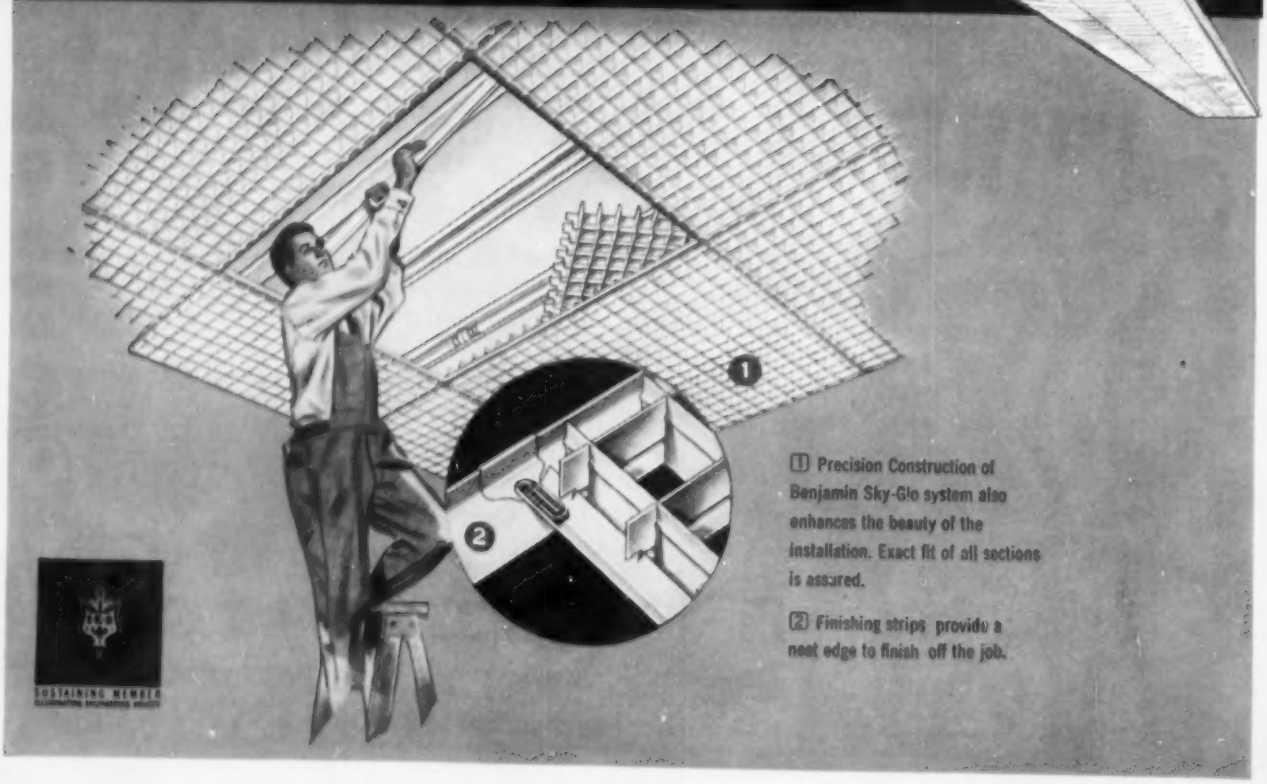
* * *

On every wiring job, large or small, where top quality materials, expert workmanship and experienced "know-how" are called for, *it pays to rely on Phelps Dodge and your Phelps Dodge distributor!*

PHELPS DODGE COPPER PRODUCTS CORPORATION

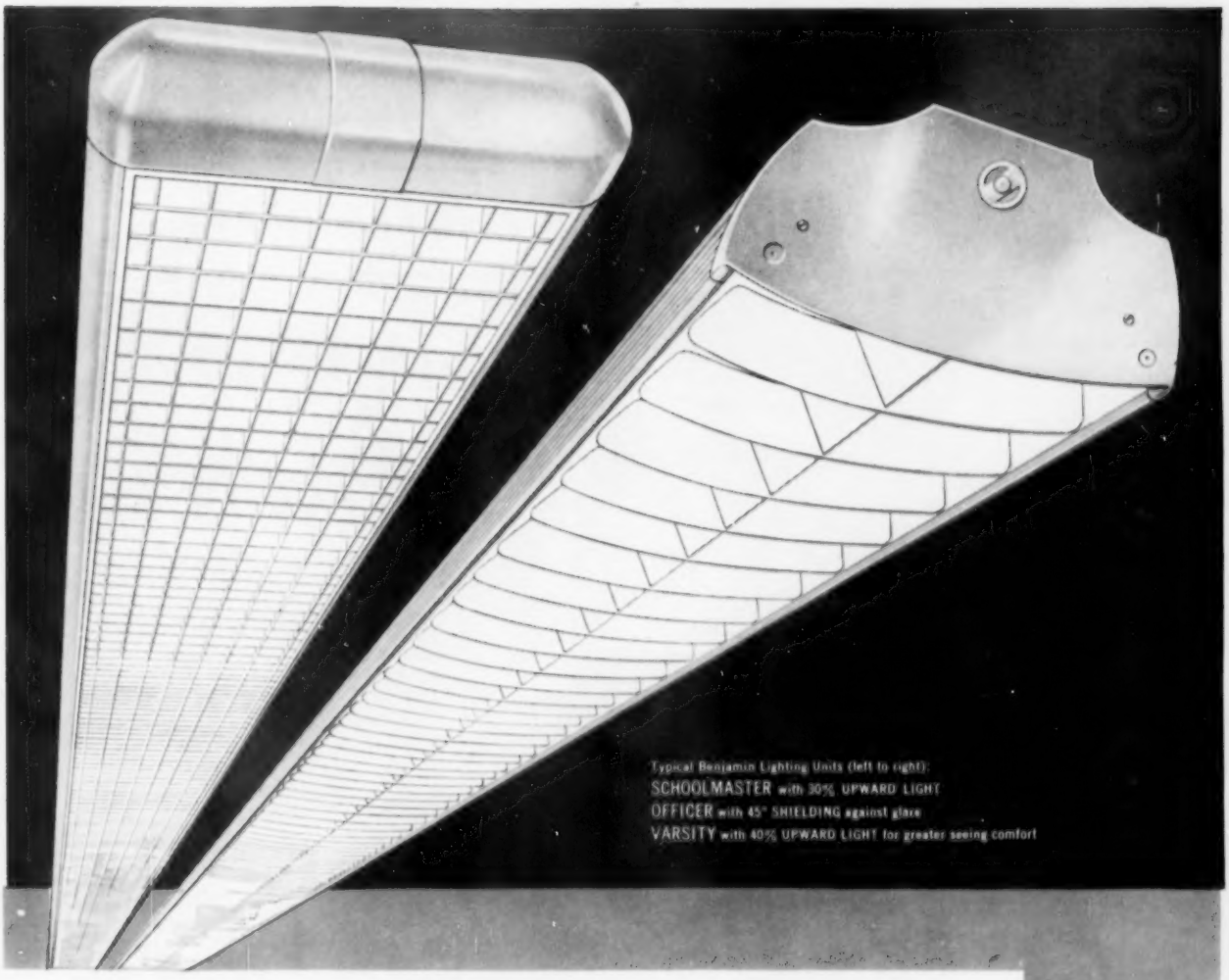
SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.





[1] Precision Construction of Benjamin Sky-Glo system also enhances the beauty of the installation. Exact fit of all sections is assured.

[2] Finishing strips provide a neat edge to finish off the job.



Typical Benjamin Lighting Units (left to right):
SCHOOLMASTER with 30% UPWARD LIGHT
OFFICER with 45° SHIELDING against glare
VARSITY with 40% UPWARD LIGHT for greater seeing comfort

When all things are Considered, the Better Lighting choice is

BENJAMIN

Compare Construction features like these; you get them all in the new Benjamin Lighting Units:

• **no fiddling with fancy louver hinges and catches:** Simple piano hinge and quick-action catches assure trouble-free opening and closing of louvers.

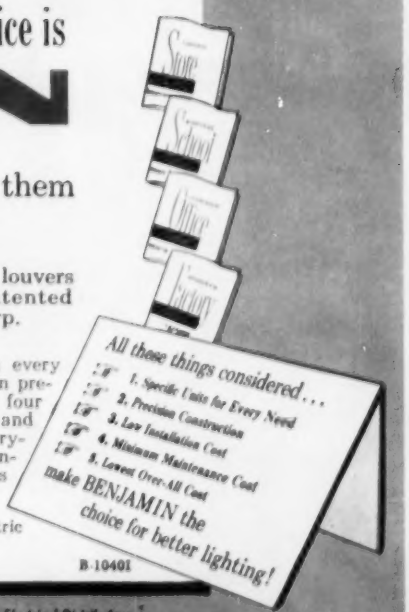
• **no "swing and sway" installations!** Benjamin precision construction assures accurate alignment of units . . . embossed channels for extra rigidity.

• **no lost motion or manpower!** All the knockouts needed are there and are conveniently located . . . no need to drill new mounting holes, either.

• **no plastics problems!** Plastic louvers are precision-molded by a patented process—always fit, will not warp.

Scores of advantages like these in every Benjamin unit are proof of Benjamin precision construction. Add the other four major areas of Benjamin superiority, and you will agree with leading users everywhere that "when *All* things are considered, the Better Lighting choice is Benjamin!"

Send for one or more of these Free lighting booklets. Write: Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Ill.



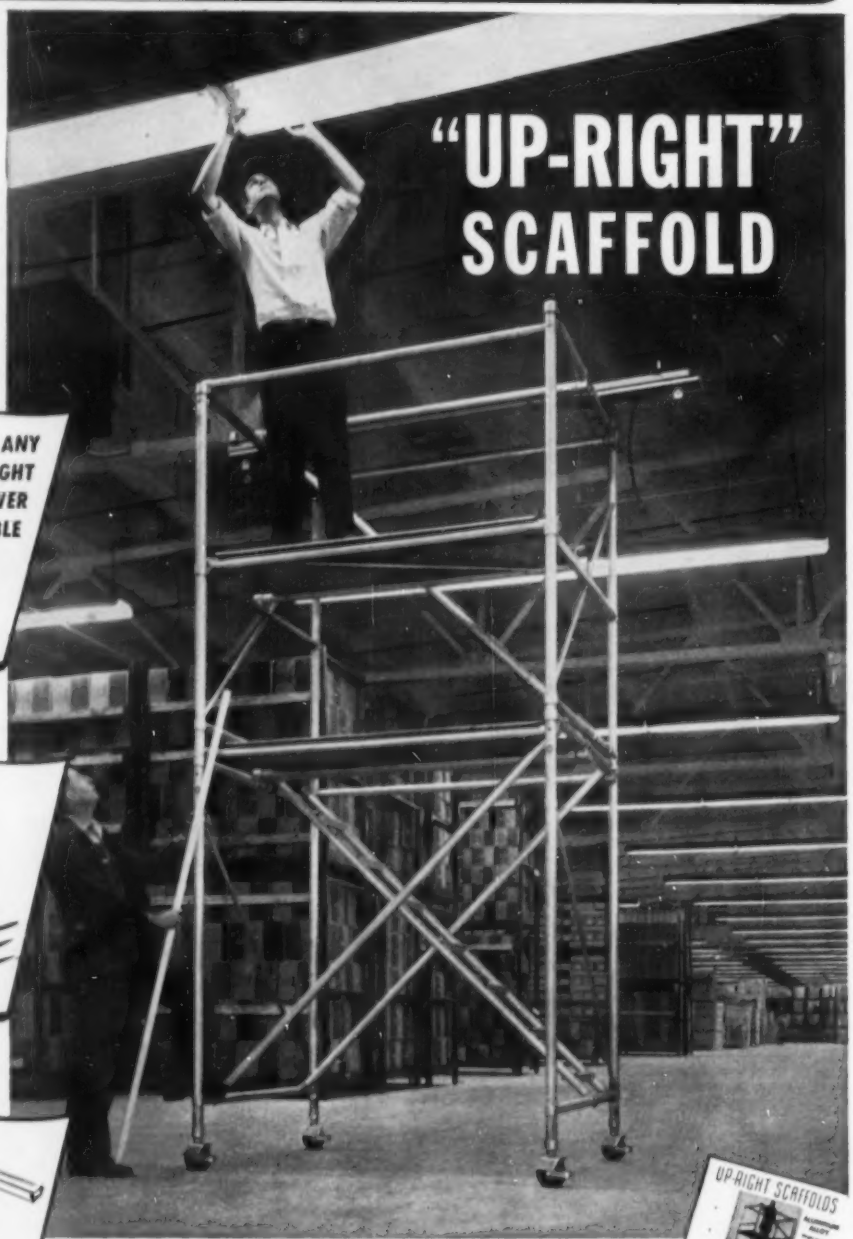
B-10401

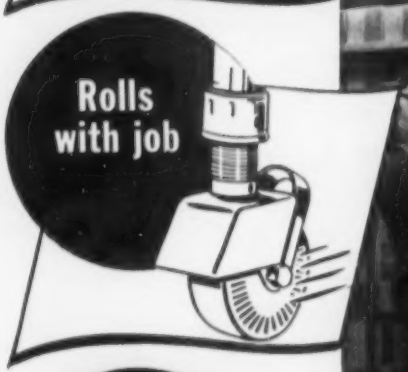
Benjamin Lighting Equipment is sold exclusively through Electrical Distributors.

WALTER D. VANCE, JR., *Vice President* • *California Electric Co., reports:*

"We saved 14 days installing 527 fixtures by using 'UP-RIGHT' Scaffold-on-Wheels"

Man-hour savings on this General Motors warehouse job amounted to over 40%. Up-Right Scaffold is so light it is easily assembled by one man. Individual 1 piece aluminum alloy sections are unfolded and set one on top of the other. They lock into place instantly.





Write for descriptive circular ➡

"UP-RIGHT" SCAFFOLDS

Dept. 159 • 1013 Pardee Street • Berkeley, California

Factories: Berkeley, Calif. and Teterboro, N. J. • Offices in all principal cities

Provides plenty of power where it's needed

National Electric Busways are designed to meet today's industrial requirements, yet provide capacity for future expansion.

Streamlined, compact, they're designed to permit the most economical, convenient, flexible and salvable layout possible.

NE "Lo-Loss" Feeder Busway

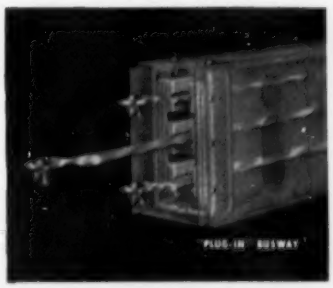
- Designed for current transmission up to 4000 amperes at 600 volts or less.
- Easy to install because single bolt connectors are used to join sections. Joints are silver-plated.
- Compact—Requires only 50% of the area needed for conduit and cable installations.
- On vertical installations, exclusive self-contained insulator support frame carries entire weight of bus bars independent of housing.
- Simple, accessible bolted connections which allow for quick and easy installation.
- Bus bars insulated with Fibron plastic tape. High dielectric strength and heat resistance.

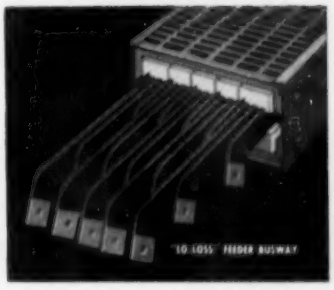
NE "Plug-In" Busway

- Rolled edge copper bus bars.
- All bus bar ends are silver-plated.
- Simplified, sliding type "plug-in" opening doors. No removable parts or springs.
- Natural gray finish baked to a hard surface inside and out.
- Insulators supported in a sturdy 12 gauge steel channel frame withstand rough handling during shipment.

For remodeling or new construction of commercial or industrial buildings, you'll find it will pay you to send for complete information on NE Busways today.

Listed by Underwriters' Laboratories, Inc.

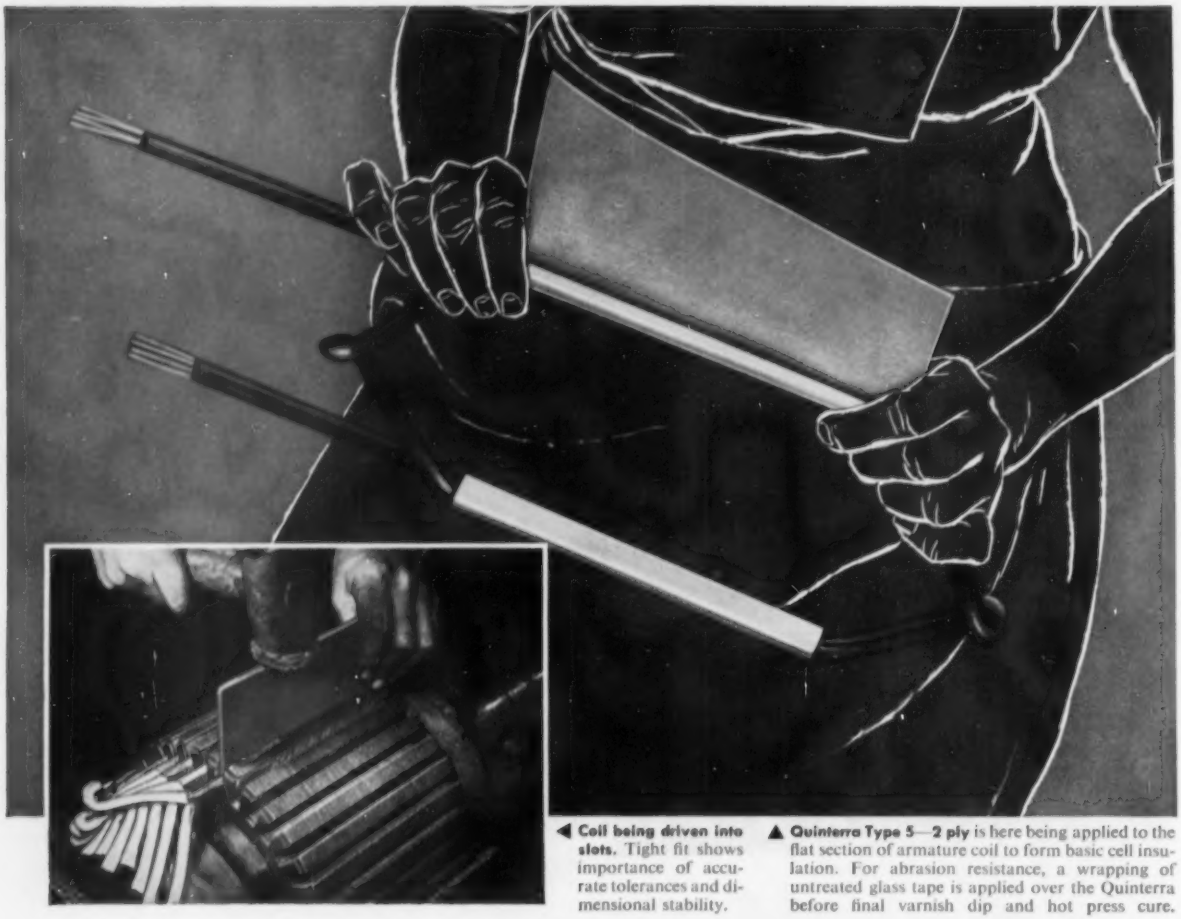




National Electric Products

PITTSBURGH, PA.

3 Plants • 10 Warehouses • 36 Sales Offices



◀ **Coil being driven into slots.** Tight fit shows importance of accurate tolerances and dimensional stability.

▲ **Quinterra Type 5—2 ply** is here being applied to the flat section of armature coil to form basic cell insulation. For abrasion resistance, a wrapping of untreated glass tape is applied over the Quinterra before final varnish dip and hot press cure.

Why West Virginia Armature Co. switched to J-M QUINTERRA® *for armature coil insulation*

West Virginia Armature Co., Bluefield, W. Va., is a leading manufacturer of motor armature coils, used by the coal mining industry—a severe and difficult field. It was only after 4 years of field testing that they decided to change to Johns-Manville Quinterra Type 5—2 ply for their traditional built-up insulation materials. They made this change because they discovered that:

1 Quinterra retains higher inherent dielectric strength under prolonged high temperature operating conditions.

2 Quinterra, manufactured to closer thickness tolerances, permits more accurately dimensioned coils, assuring easy and proper fit.

3 Quinterra is pliable, conforms readily to shape of coil and remains dimensionally stable in storage or in use.

4 Quinterra is smooth, does not crack or flake, is easy and pleasant to handle, does not harm or irritate operators' hands.

5 Quinterra is flexible, eliminates dielectric failures due to flaking or splitting.

Quinterra Type 5—2 ply is made from two sheets of highly purified asbestos treated with a polyvinyl acetate resin saturant and combined under controlled temperature and pressure. It has ample mechanical strength for easy handling. Its inherent dielectric strength exceeds 280 VPM even at temperatures over 130 C.

Find out how you can obtain the same benefits from Quinterra. Write for free 32 page illustrated brochure, EL-40A. Address Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit (Toronto), Ontario.

Dimensional accuracy is imperative. Here, finished coils are being tested in Go-or-No-Go gauge.

Johns-Manville ELECTRICAL INSULATIONS

THE TROFFER with the *built-in profit* FEATURES!

Take the patented Smithcraft Yoke-Aligner Hanger Assembly* for example. It's responsible for your being able to install Smithcraft troffers in far less time than required for conventional fixtures. It's the feature that permits you to level the troffer *before* or *after* installation is completed!

Take the fact that only a screwdriver is required for installation. Or the adaptability of this troffer to any type of ceiling. These are just a few of the cost-reducing features which Smithcraft has built in to this outstanding troffer.

*Patent #2,597,875 other patents pending

America's finest fluorescent lighting...

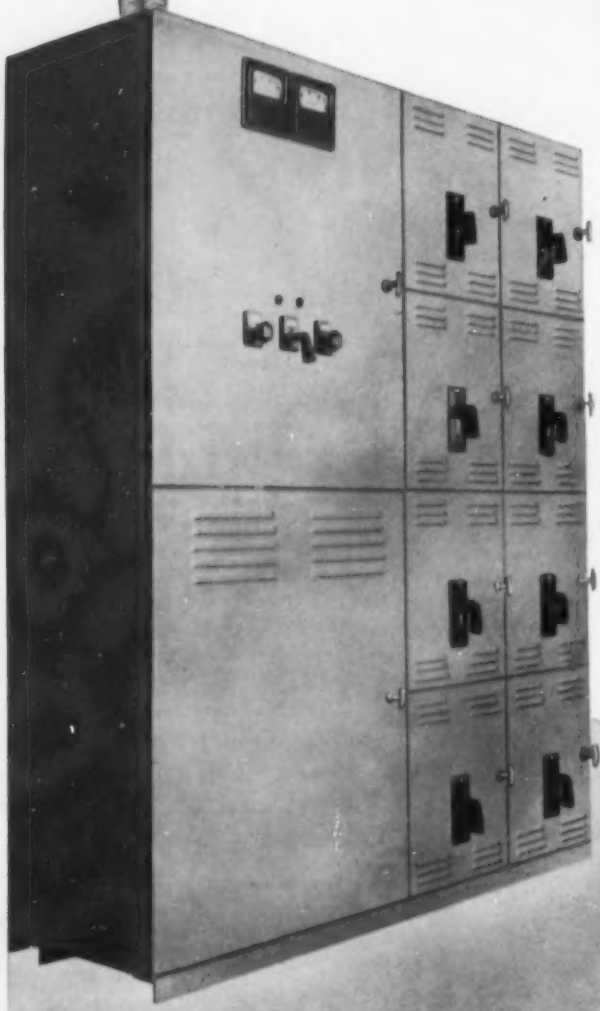
It's a fact . . . Smithcraft Troffers are designed with features that help electrical contractors cut down on installation time and cost! These are ***exclusive*** features . . . and because they can't be found in any other recessed fluorescent lighting equipment, you owe it to yourself to make us prove our statement!

Get the whole story! Send today for the complete Smithcraft "Architectural Troffer" handbook! You'll find that it's your guide to extra profits in recessed lighting!

Smithcraft
LIGHTING DIVISION
CHELSEA 50, MASSACHUSETTS

BUSGEAR

CO-ORDINATED ELECTRICAL SYSTEMS OF BUSWAY and SWITCHGEAR



In modern industrial and commercial buildings, there are two major components of electrical distribution systems, *bus*way and switch*gear*.

Uni-Bus busway provides a new concept in electrical distribution. Industrial and commercial installations are more flexible, safer and truly economical with the new Uni-Bus busways.

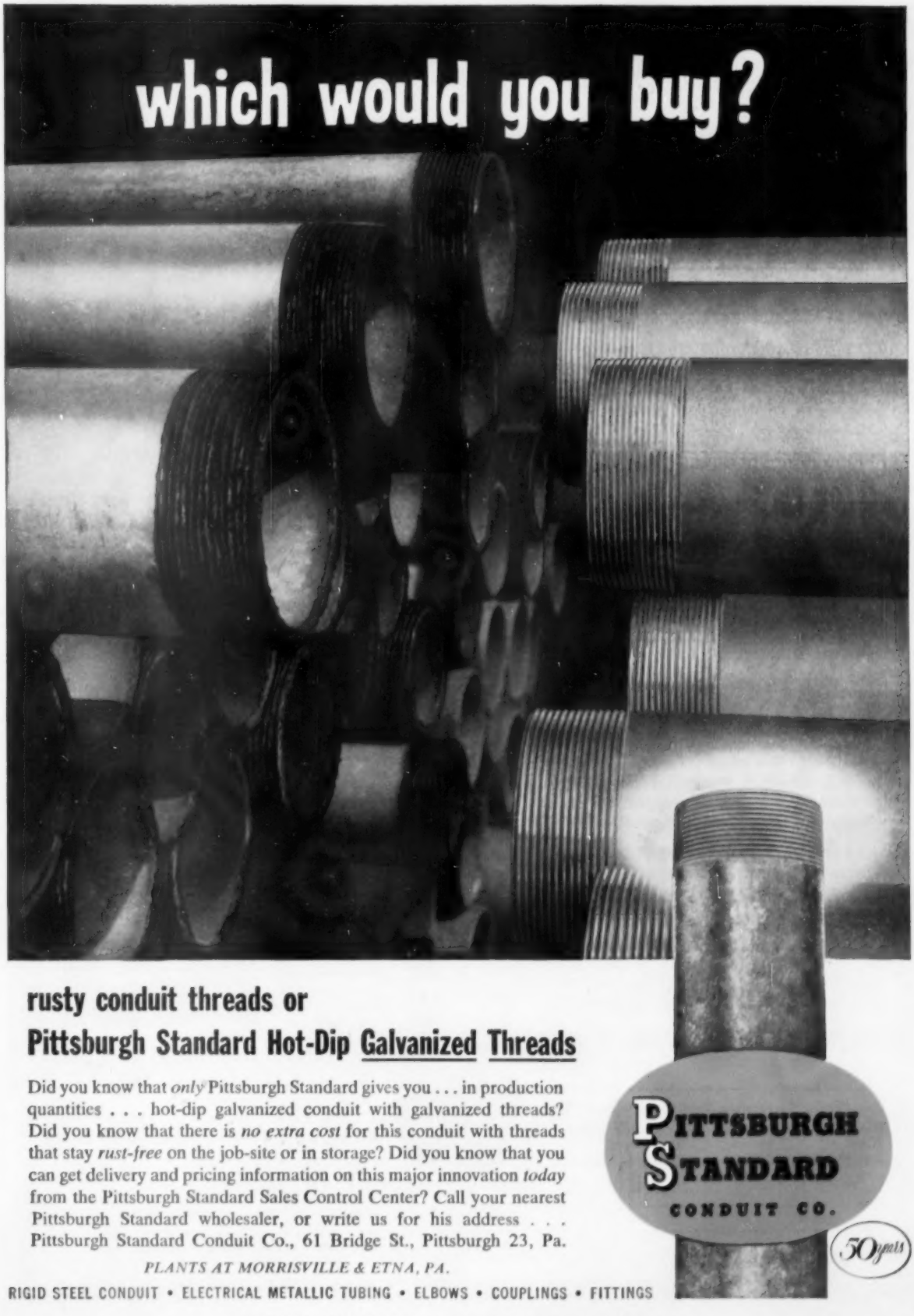
For numerous tap-offs, as in industrial plants, the Uni-Bus plug-in system is ideal. To carry current from one point to another with only a few tap-offs, as in lighting risers in office buildings, the Uni-Bus feeder system is most economical.

To obtain maximum efficiency from the Uni-Bus system, co-ordinated overload and short-circuit protection is essential. This is accomplished best with Roller-Smith switchgear expressly designed with that aim in view. Extensive testing at Roller-Smith is the basis for sound engineering co-ordination between Uni-Bus *bus*way and switch*gear*.

That's why we selected the name BUSGEAR to identify the completely co-ordinated system manufactured by Roller-Smith under *one* roof and under the supervision of *one* Engineering Department.

Roller-Smith
CORPORATION
BUSWAY and SWITCHGEAR
BETHLEHEM, PENNSYLVANIA

which would you buy?



rusty conduit threads or
Pittsburgh Standard Hot-Dip Galvanized Threads

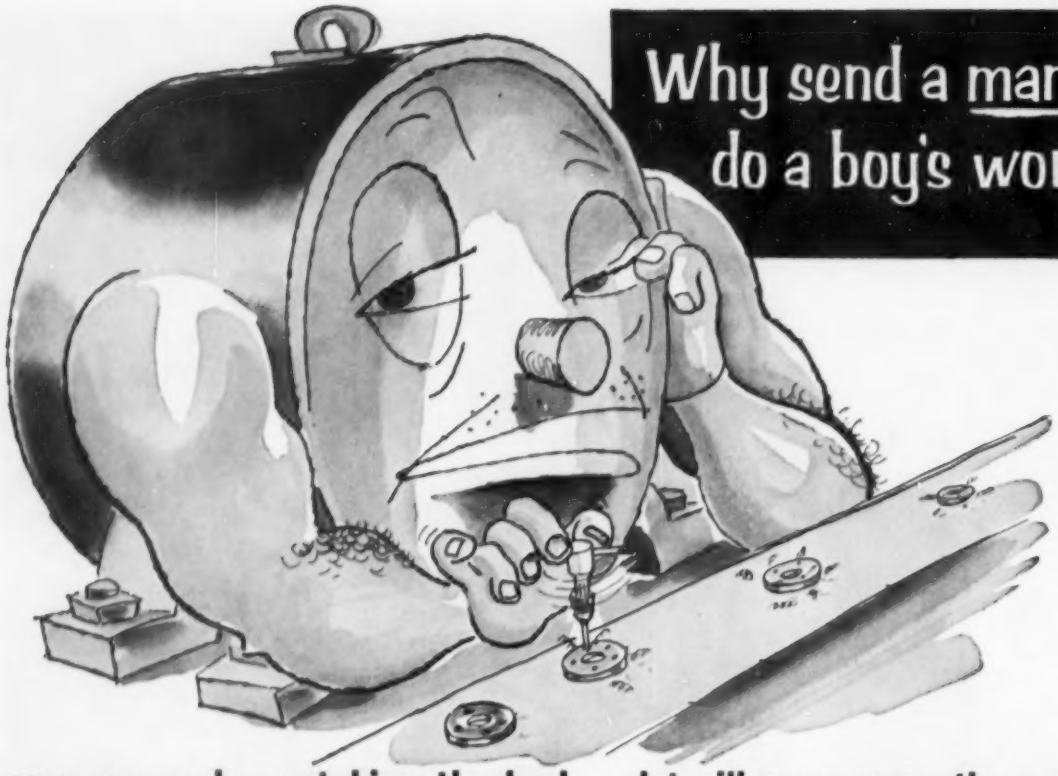
Did you know that *only* Pittsburgh Standard gives you . . . in production quantities . . . hot-dip galvanized conduit with galvanized threads? Did you know that there is *no extra cost* for this conduit with threads that stay *rust-free* on the job-site or in storage? Did you know that you can get delivery and pricing information on this major innovation *today* from the Pittsburgh Standard Sales Control Center? Call your nearest Pittsburgh Standard wholesaler, or write us for his address . . . Pittsburgh Standard Conduit Co., 61 Bridge St., Pittsburgh 23, Pa.

PLANTS AT MORRISVILLE & ETNA, PA.

PITTSBURGH STANDARD CONDUIT CO.

50 years

RIGID STEEL CONDUIT • ELECTRICAL METALLIC TUBING • ELBOWS • COUPLINGS • FITTINGS



Why send a man to do a boy's work?

save money by matching the load . . . let silicones carry the overload!

You get a service factor ranging up to 50% with Dow Corning Silicone insulated (Class H) motors compared to 15% for Class A.

This built-in service factor saves you the initial cost of installing oversized motors to withstand the heat generated in reversing service, for example. In many applications, it saves the cost of over-motoring to carry intermittent overloads, or loads that can't be matched in standard frame sizes.

And eliminating the need for over-motoring gives you a better power factor and higher efficiency, because the smaller silicone insulated motors come closer to operating at full load most of the time.

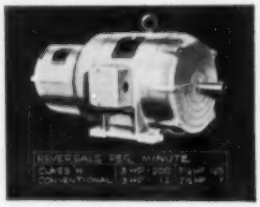
You also get more reliable service because motors insulated with Dow Corning silicones have superior resistance to heat, to a combination of heat and moisture, and to corrosive atmospheres.

Remember over-motoring is outmoded

to help you speed up production

LOUIS ALLIS

The Louis Allis Co. of Milwaukee has developed a line of rapid reversing motors which are silicone insulated and blower cooled to give a maximum number of reversals. A 3 hp Class H motor, for example, will do 200 idle reversals per minute compared to 12 for a conventional motor of the same frame size. A 7½ hp silicone insulated motor will do 125 idle reversals per minute compared to 7 for a conventional motor. These motors offer new production economies in any operation where high reversal capacity is required.



Dow Corning Corporation, Dept. 3903, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

☐ Information on Louis Allis motors for rapid reversing service

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

DOW CORNING SILICONES

DOW CORNING CORPORATION

MIDLAND, MICHIGAN

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT
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CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris

Four Steps That Mean

Easier, Quicker, Safer Installation of

CRESCENT

A B C ARMORED CABLE

1 FILE OR SAW GUIDED BY CUTMARK

2 BREAK ARMOR

3 PULL OUT PAPER

4 INSERT INSULATING BUSHING

★ **NOTE CUTMARK** on the fourth turn from right on armor of cable above. This cutmark (at 1½" intervals) shows the location of a prefabricated breaking line inside the armor. Only a few strokes of a file or saw guided by the cutmark are required to cut through one outer ridge, and a bend by hand severs the armor. This results in a clean separation with no sharp edge—a safer, easier and faster job. The prefabricated breaking lines are so designed that there is *no reduction* in tensile strength, bending quality, crushing resistance and electrical conductivity of armor.

★ **NOTE BOND WIRE UNDER ARMOR** which is in contact with the under side of each convolution. This provides permanently low armor resistance. It is furnished in sizes No. 14 and 12 AWG Cable.

★ **GENUINE A B C CONSTRUCTION** provides for easy insertion of the insulating bushing because the paper under the armor readily *unwraps from under both ends* providing space to insert the bushing.

★ **ALL GLASS BRAIDS** protect the rubber insulated conductors, and are flame, moisture and rot proof. The use of ALL GLASS braid results in a cable with smaller diameter and lighter weight, being easier to handle and install.

CRESCENT
WIRE & CABLE

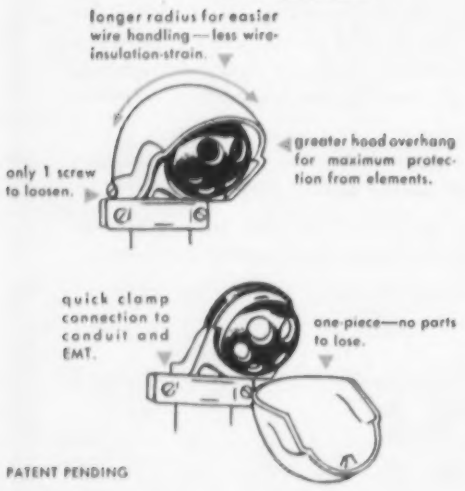
OVER 70 YEARS EXPERIENCE

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, N. J.

new "swing top" entrance cap

with the hood that hangs on a hinge!



PATENT PENDING

FOR EASIER, COST-SAVING INSTALLATION

Cut entrance installation time by *two-thirds* with Efcor's new "Swing Top" entrance cap. Loosen one screw, swing the hood open . . . that's all it takes to pull wires through the head! The patented, one-piece hinged construction retains the hood until you're ready to replace it. With conventional units, you're required to loosen several screws, completely remove the cover, put it in your pocket, or on the ladder where it might fall to the ground. "Swing Top" also has a longer radius to facilitate wire pulling and minimize strain on wire insulation. The rugged clamp connector permits quick attachment to conduit *directly against the wall.* No threading, no offsetting needed . . . accommodates EMT too.

WRITE FOR FREE SAMPLE *or see your Electrical Distributor.*

Efcor Reg. Trade Mark

electrical fittings corporation

37-50 57th STREET • WOODSIDE 77, NEW YORK

ELECTRICAL CONSTRUCTION AND MAINTENANCE

55th Year—MARCH • 1956

Ceiling Jurisdiction

Electric ceilings, besides opening a spectacular new era in lighting, brought the industry some new problems. So long as lighting fixtures were small, obvious and distinct from structure, they were universally recognized as electrical equipment furnished by electrical contractors and installed by electricians. No questions were raised as to craft jurisdiction, methods of installation or the materials involved in the fixture assembly. The electric ceiling, however, which coordinates many components into a single lighting fixture, is now being challenged from many sides.

Traditional ratios of electrical work to construction cost are often upset by the electric ceiling. It is a ripe plum for the electrical contractor and a substantial value for the customer. It eliminates, however, the need for the conventional suspended ceiling or ceiling finish which results in some reduction in the work usually performed by other contractors. Of this they, and their building material suppliers, take a very dim view.

Adding to the turbulence are the craft unions. In Detroit, a few weeks ago, 125 carpenters armed with hammers drove 68 electricians off a job. They claimed the installation of the reflecting panels of an electric ceiling because the panels were made of fiber glass. The carpenters were later backed up by the Joint Board of Arbitration of the AFL-CIO in an astounding reversal of policy.

One hassle is not necessarily an industry-wide crisis, nor is a single adverse jurisdictional decision vitally significant. The electric ceiling is still, in all common sense, an electric lighting fixture. Reflective, diffusing and source components are integrated, functional elements of the lighting system, regardless of the raw materials of which they happen to be fabricated, and regardless of whether they occupy 5% or 100% of the available ceiling area. Illumination, furthermore, is an established field of professional engineering and the coordination of reflective, diffusing and source components are of the very essence of illumination design and application.

But the warning is clear. It is time for the whole electrical team to take a new look at the lighting business, its relationships and trade practices, its strengths and weaknesses in the light of a common danger. There are predatory interests abroad. They want in, where they have no business. Electric lighting is the business of the electrical industry. Let's keep it that way.

Wm. T. Stuart

Wrenches to wire pullers—tools that help make better workers and smooth operations are quickly available via Graybar. Your local Graybar Representative will be glad to help you select tools in a size, capacity and ability to meet every requirement. Check your telephone directory. Call Graybar *first!*

TOOLS for MAINTENANCE–CONSTRUCTION–PRODUCTION

—from over 130 Graybar locations

Tools that help get the job done faster are available from Graybar offices and warehouses located in the principal cities of the nation.

A phone call brings prompt attention. Every Graybar location is geared to give you accurate price, specification and delivery information on hand, mechanical and motor-driven tools.

You save buying time, paper work and avoid delays through Graybar's centralization of order assembly, shipping and billing procedures.

You get up-to-date tools of proven design and construction for hard usage—all products of well known manufacturers.

You'll discover that Graybar is the most convenient *single* source of everything electrical. We welcome your inquiries, both large and small. Graybar Specialists in the major electrical fields are available to advise and consult with you and your customers.

Users of electrical equipment in U.S.A. and possessions can have a free copy of this catalog—one of the most comprehensive on electrician tools ever published. Send us your name, firm, and address. 627-43

CALL **GraybaR** FIRST FOR Graybar Everything Electrical

GRAYBAR ELECTRIC COMPANY, INC., 420 LEXINGTON AVENUE, NEW YORK 17, NEW YORK, IN OVER 130 PRINCIPAL CITIES

MODERN SHOPPING CENTERS require substantial electrical installations. Design includes everything from branch circuits, secondary distribution, load-center substations, to primary systems to serve the vast area.

FUNDAMENTALS OF

Shopping Center Electrical Systems

Layout of service and distribution requirements starts with basic electrical design units, then primary and secondary distribution systems. First of a series.

By R. J. Abramson*
Consulting Engineer
Chicago, Illinois

SHOPPING centers are being built in all sections of the United States. The lure of suburban living and the sharp increase in housing developments in outlying areas have created a demand for centralized shopping facilities to serve this new pattern of family life. The modern shopping center with its variety of merchandising outlets and acres of off-street parking is the answer. Generally located in a "wide open space" within a few miles of a concentration of population, the shopping center creates a number of electrical design problems not found in cities or towns where utility distribution networks are available. A number of these will be pointed up in this series of discussions dealing with shopping center electrical systems.

Shopping centers, as we know them, fall into two categories: (a) local and (b) regional.

The local shopping center is usually thought of as a unit consisting of 20 to 30 stores occupying approximately 150,000 sq ft of floor space. Usually, no major department store is a member of this group.

Regional shopping centers are generally in excess of 150,000 sq ft and have one or more department stores, each occupying an area exceeding 60,000 sq ft.

For the purpose of this series, discussions will be confined to the local shopping center. Basically, the following phases of electrical system design inherent to shopping center application will be covered:

(a) Types of service
(b) Distribution—exterior
(c) Parking and canopy lighting
(d) Building distribution
(e) Store distribution

Basic Design Loads

Shopping centers differ from most construction in that definite electrical loads are not known when the project is being planned. During preliminary design stages, only one or two of the major tenants may be known and their electrical requirements definitely established. Other stores in the center may not be leased until construction has started or is well under way. The electrical engineer must, in effect, start from scratch and assign unit loads to calculate secondary feeder sizes, and transformer capaci-

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Chicago, Illinois

ties, and proceed to design the primary distribution system.

To intelligently estimate the *approximate total power requirements* for a project, we have devised a "rule of thumb" set of load units that has been tried and proved on numerous projects. These design loads are applied as follows: 10 watts per sq ft for sales area nearest to and above grade; 5 watts per sq ft for sales areas below grade. For storage areas, stockrooms, marking rooms, etc., nearest and above grade, 5 watts per sq ft is used; below grade, 3 watts per sq ft. These units recognize average store lighting and power requirements, including air conditioning for the normal retail merchant. However, *the load estimates always must be checked against the tenants' final leasing requirements and corrected accordingly.* Once estimated loads per store and building groups are determined, it is desirable to break these groups into feasible load centers.

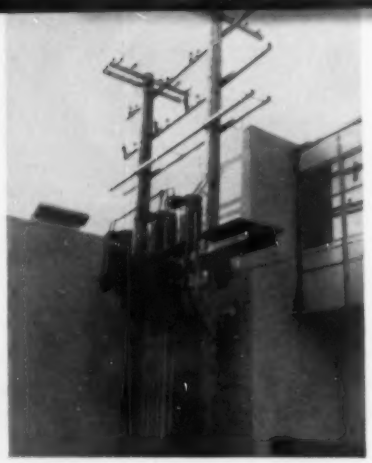
In most cases shopping centers are in relatively undeveloped areas and comprise from 12 to 30 acres of ground. It is necessary to have a distribution system within the proper confines, usually located in easements. The most economical arrangement is generally where the power company installs an overhead pole system at the rear of the building groups and installs pole-mounted transformers near the calculated load centers. Capacity of these load centers then should be as close as possible to the power company's maximum size of transformer. For example: a 500-kva group could have three 167.5-kva transformers. Similarly, load centers would range downward as required. At this point the designer must make up his mind as to the type of secondary distribution system he will use.

Secondary System

Our experience in this field has been that the use of a 4-wire, 3-phase, 120/208-volt secondary distribution system is the most flexible and the most economical in first cost. If the power company (they usually do) permits this form of installation, then secondary distribution can be a one-service type providing power and lighting from a single service for each tenant. Grouping a number of stores to a load center permits the designer to take advantage of diversity inherent in multiple services.

Assuming that this choice of distribution is made, then the minimum number of load centers for the project is determined and the smallest number of primary aerial feeders to the pole-mounted transformers is obtained. It is undesirable to have a forest of wires from a low voltage distribution system on poles with an aerial for each store. Most architectural firms frown upon this practice. To eliminate this unsightly aspect, a meter room is generally installed adjacent to each load center within the building, either on a first floor or in the basement (if there is one). Individual meters are installed in this public, accessible room with services then extended to the several tenants contained within this load center.

In many instances communities



POLE-TYPE SUBSTATION served by aerial primary circuit transforms voltage to 120/208-volts. Note secondary bus under platform to which 3-phase, 4-wire store feeders are connected.

ELECTRICAL DESIGN PROCEDURE

Compute total square-foot area of floor space involved.

Determine total square-feet or acres of parking lot area.

Compute total electrical loads for each store or area by applying the watts/sq ft or watts/lineal foot design units.

Add kva allowances for festoon, sign and directory lighting.

Check load estimates against final leasing requirements of individual tenants and adjust accordingly.

Combine or divide loads into logical "distribution center" groups according to good economic and engineering practice.

Select the most flexible and economic type of secondary distribution system dictated by good engineering practice. (3-phase, 4-wire, 120/208-volt, aerial, wall-racked raceways or underground).

Determine the number, type (pole, roof-top, ground level or underground), and location of "distribution centers" necessary and size of transformer banks needed at each to serve grouped loads and keep secondary runs to minimum lengths.

Select most economical primary voltage and design primary distribution system accordingly, and in compliance with local regulations.

Check with local utility on whether primary distribution system will be property of the utility or shopping center owners; also easement requirements.

APPROXIMATE DESIGN LOADS FOR SHOPPING CENTERS

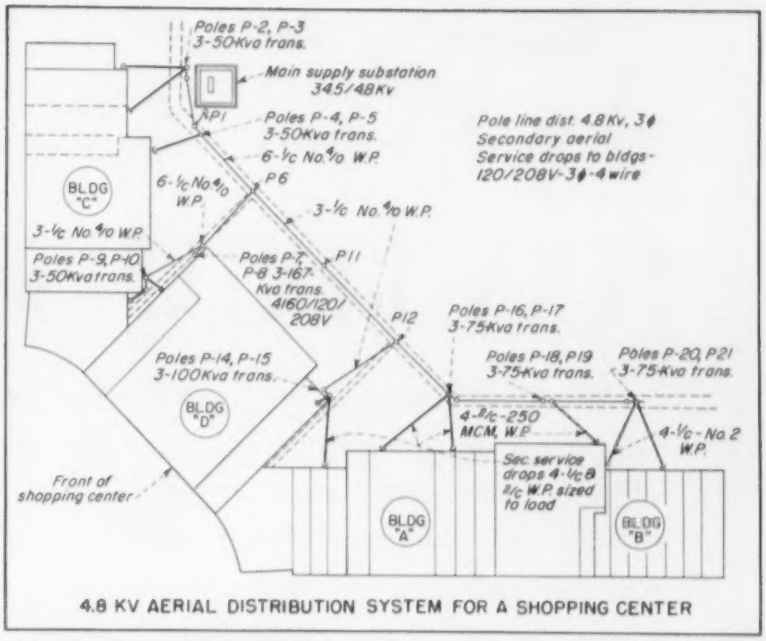
TYPE OF INDOOR AREA	DESIGN LOAD
Sales	
Near and Above Grade	10 watts/sq ft
Below Grade	5 watts/sq ft
Storage, Stockrooms, Etc.	
Near and Above Grade	5 watts/sq ft
Below Grade	3 watts/sq ft
TYPE OF OUTDOOR AREA	**DESIGN LOAD**
Parking Lots	0.1 watt/sq ft or 4.5 to 5 kva per acre for 0.5 to 0.8 footcandles
Canopy Lighting	15 watts/lineal foot
Sign Lighting	35 kva allowance for large sign and one to 2 smaller ones
Festoon Lighting	15 kva allowance
Directory Lighting	1.5 kva allowance for 5 to 8 directories

Notes:

1. Above units include average store lighting, power and air conditioning requirements for the normal retail merchant.
2. Total estimated load per store based on these units should be checked against tenants' final leasing requirements and adjusted accordingly.

will permit the use of "T-Tap" feeders. In fact, permission was secured for the use of this type of connection for a shopping center in the city of Chicago just recently. In this case the central meter room can be eliminated. A single conduit service feeder installed either on the building wall or below grade, adjacent to the exterior building wall, can be tapped for service for each individual store tenant. This permits the installation of a meter in each tenant's space which is the preference of most store owners.

Inherent in the statements above is the use of a 4-wire system to each tenant. The balancing of lighting systems across the phases and the use of 3-phase motors is a simple way to balance the feeders and take advantage of the reduction of current per leg of a set of feeders inherent in a 3-phase system. With the use of 4-wire panels and small power distribution blocks, simple standardized panelling can be used throughout the entire project. Each tenant, in turn, has the advantage of using small single-phase motors or larger and less costly 3-phase motors for whatever power equipment he may have.



4.8 KV AERIAL DISTRIBUTION SYSTEM FOR A SHOPPING CENTER

4.8-KV AERIAL DISTRIBUTION for a shopping center. Primary pole-line is located on utility easement (dotted pathway) with transformer poles strategically spotted. Length of secondary drops to buildings is kept to a minimum.

Other Load Estimates

In addition to the estimated loads for the stores of the project, allowances must be made for the lighting of the automobile parking areas, canopies, malls, festoon lighting (for holidays), project signs, and other miscellaneous applications.

Experience with many parking areas has demonstrated that between 5/10 and 8/10 footcandle in mercury-vapor lighting is ample and usually desirable. Converted into watts, this would mean approximately 1/10 watt per sq ft of parking area. In other words, for each acre of parking, approximately 4½ to 5 kw of lighting will be required.

For canopy lighting an allowance of 15 watts per lineal foot of canopy should be made. It is somewhat desirable that the feeders for the parking lighting and canopy lighting terminate at a common panel as most owners wish to control the operation and generally the current is paid for by the owner. Here again we have used a 4-wire system successfully taking a phase and neutral per circuit with approximately six double light standards. The light standards are usually equipped with the EH-1 mercury vapor luminaire requiring an operating wattage of approximately 400. This would rate the average circuit at 3,520 watts.

In addition to the loads already mentioned, the average project requires a main sign of approximately 25 kva and one or two smaller signs of 5 kva. Generally a sign allowance of 35 kva is made. An additional allowance of 1½ kva for curb directory lighting should be ample.

Festoon lighting and special event lighting is generally provided for by outlets on the light standards and on the exterior fasciae of the canopies or building walls. A lump allowance of 15 kva is usually made for this purpose.

When the completed estimate is made, it is well to sketch the required utility distribution system and the number of load centers. Also included should be the estimated tenant's requirements and parking and canopy lighting.

Underground Service

In many localities architectural designers feel that the additional cost of underground service is warranted for the sake of appearances. In this case, the use of below-ground transformer rooms and underground radial services to the several tenants is the most desirable and the least expensive to engineer. The implication is that the designer would run one or more "T-Tap" services below grade with intermediate electrical manholes to tap one or more tenants off the service feeder at each manhole.

In some instances architects have provided masonry wall enclosures without roofs and have permitted the use of underground feeders to grade-mounted transformers. These enclosures are designed to blend with the general composition of the project. Here again the same limitations apply as to expense as in the completely underground system. In addition the initial costs are increased by the vault or wall construction and the underground high voltage feeders.

Once the designer has determined the method of distribution, his preliminary plans should recognize the necessary easements that will be required by the utility company. Each company's requirements vary somewhat. Generally they are from 10 to 15 ft in width and extend the length of the primary system and one more of the property lines at a point of entry required by the utility company. One suggestion is that this be the first order of business after estimating the loads. Then both designer and the utility company can coordinate their efforts.

PENN CENTER REBUILDS

Completion of modern 20-story office skyscraper in downtown Philadelphia marks beginning of impressive 20-acre rehabilitation program. Vertical busduct distribution, extensive remote control system, complete air conditioning, Autotronic elevators and dual electrical services reflect high order of progressive design.

Caywood C. Cooley
Electrical Engineer and Vice President
The Harry F. Ortlip Company
Philadelphia, Pa.

FIRST structure to materialize on the site of Philadelphia's fabulous Penn Center (and that city's first major skyscraper to be erected in a quarter-century, incidentally) is a handsomely trim office building containing 480,000 sq ft of rentable floor space and rising to a height of 250 ft.

Modern in every respect, from marble-and-stainless-steel lobby to its utility core, it is generally lighted by recessed fluorescent luminaires; is electrically served by vertical bus ducts; is equipped with 11 Autotronic passenger and three freight elevators, and is completely air conditioned through the medium of 1200 zone-controlled heating-cooling units. Erected on a framework of steel structural columns and open-web floor joists, it is sheathed with alternate tiers of limestone and glass—a construction combination that provides maximum natural light, maximum flexibility for floor space arrangements, maximum fire protection and maximum convenience for locating conduit runs, utility piping and recessed lighting fixtures in unobstructed open-joist areas beneath floor slabs.

As the first Penn Center building to be completed, this structure establishes a worthy standard for subsequent projects to emulate. And, as an example of modern design and construction, it reflects architectural skills of Emory Roth & Sons, New York; building know-how of Uris Brothers, also of New York, and electrical engineering and installational ability on the part of Harry F. Ortlip Company, Philadelphia.

Vertical Bus Ducts

Main artery for upper-floor power distribution is via four 3-phase 4-wire low-reactance bus ducts that are carried upwards through vertically tierred electrical closets. Three of the ducts are 1600 amps serving floors 2 to 6, 7 to 11 and 12 to 16 respectively. The fourth duct, rated at 1350 amps, serves everything from the 17th floor up, with the exception of air conditioning equipment plus lighting and motors in the penthouse fan and elevator machine and control rooms.

Ducts are 8-bar assemblies, with bolted connections at scarf-lapped joints combining spring cup washers (to maintain high pressure contact) and spline nut inserts (to permit closer spacing of bars and thereby minimize reactance and voltage losses). Bars are wrapped with varnished cambric except at joints, where insulation is provided by vinyl snap-on sleeves. Physical protection and ventilation results from the casing construction of expanded metal.

Vertical ducts are supported at every floor level as they pass upwards through successive slab slots. This is accomplished with horizontal 2-by-2-in. angles, welded to duct casings and end-supported by 6-in. channels that bridge the slots at either side of the ducts. Leveling screws in the angles at their channel-bearing points permit exact adjustment in each closet.

Distribution panels for individual floors are mounted directly in front of, and top-connected to, the ducts serving them; panels being independently supported and leveled by means of conduit legs and threaded flanges. At present, each panel contains three 200-amp 3-pole switches, connected to three 32-circuit lighting panels through a front-access 6-by-6-in. wiring trough, while space is available for the addition of a fourth switch and lighting panel if future load growth demands it.

Distribution of power for lighting, air conditioning units, floor and wall receptacles is via slab-incorporated conduits; lighting circuits being carried overhead in the slabs above, then stubbed down into hung-ceiling cavities for con-

MODERN SKYSCRAPER—first structure to be completed in Philadelphia's impressive central redevelopment program—rises alongside old Penn-topped City Hall landmark, thereby symbolizing transfusion of healthy new commercial blood into heart of country's third largest metropolis.

nection to fixtures and local control switches; all other circuits being carried in the slabs below.

As indicated by an accompanying diagram, power for perifery air conditioning and ventilation units is initially carried via rigid conduits in slabs to two central outlet boxes located at midpoints of north and south wall lines on each floor.

It is then distributed laterally via flexible conduit to 34 boxes located 24 ft apart, i.e., on interior surfaces of parapet walls at midpoints between adjacent exterior structural columns. These surface-mounted lateral runs, hidden from view by ventilator enclosures installed continuously beneath window areas, are recessed into walls proper at parapet-column intersection points in order to by-pass column fireproofing.

Power Tools

To provide incidental power to open-floor areas, 4-in. round boxes with 5-in. flange covers were recessed into slabs and were bottom-fed by flexible conduit connections installed beneath slabs in hung-ceiling spaces. Cylindrical holes for these boxes were cut with a diamond drill after slabs were poured; 4-in. holes for boxes extending completely through slabs, and 5-in. diameter shoulders going only deep

Rarely does a long-established major city have the opportunity to reconsider, replan and redevelop its industrial and commercial heart centuries after its founding. Yet that is the vast project now taking place in Philadelphia, the nation's third largest city.

The Penn Center area being revamped is a 20-acre section in the center of town, extending approximately a mile westward from age-worn City Hall, reaching north and south to encompass 25 city blocks, and involving new construction which will eventually exceed $300-million.

Already completed is a modern 20-story office skyscraper with several more duplicate offices to join it in the near future. An ultra modern 1000-room hotel is also under way, as is a vast newspaper headquarters and a transportation center which will combine plane and bus facilities with a thousand-car garage. Soon to be started is a 20-story apartment house, plus an imposing array of smaller business and shopping establishments. All of these buildings will be joined by an underground concourse leading to Philadelphia's new suburban railroad station and its two main subway systems.

This complete redevelopment is following a coordinated plan prepared by top-flight architectural and civic-center authorities. Therefore the entire area will have a unity and efficiency which would be otherwise impossible. When completed, it will represent one of the most beautiful business centers in the country, for the many harmonizing structures will be grouped around a spacious 800-ft-long esplanade, plus several landscaped plazas and sunken gardens.

Arising on property made available by the removal of the Pennsylvania Railroad's 70-year-old Broad Street Station, multiple tracks which served it and a famous but unsightly "Chinese Wall" viaduct which flanked it, this new business community is adjacent to the city's firmly-established civic, cultural, business and shopping hub. And, measuring up to the highest standards of overall utility and efficiency, this center literally constitutes a mile of opportunity possessing convenience, prestige and supurb commercial advantages in an impressive mid-city setting.

Significantly, this vast rebuilding program with its attendant accent upon progressive electrification coincides with the 250th anniversary of the birth of Benjamin Franklin, whose name is so closely linked with electrical pioneering and Philadelphia's early history. Therefore, to symbolize Philadelphia's continuing electrical progress, it seems fitting to select the famous bronze bust of Franklin, by Jean Antoine Houdon, now on exhibition in the Burndy Library of the Sciences in Norwalk, Conn.—The Editor

HIGH VOLTAGE switchgear (left) is connected by means of overhead ventilated low-reactance busduct bridges to separate power and lighting switchboards. Substation contains four 1500-kva transformers; two stepping 13.2-kv current to 480/277 volts and two reducing it to 208/120.

THOROUGH CHECKING and adjustment of components in primary and secondary switchgear assemblies were completed after reassembly of sections had been completed. All substation cubicles are dead-front free-standing units, grounded via bare copper cables to driven rods and cold water main.

LIGHTING PANELS (three per floor at present with space for a 4th if required in the future) are 32-circuit-breaker units, bottom-connected via a 6-by-6-in. wiring trough to the main distribution panel. Gutters are liberally dimensioned to facilitate connections of branch circuits.

enough to recess flanges level with finished floors. In areas where private partitioned offices were erected, partitions were located directly above these floor outlets so that extensions to baseboard receptacles could be carried through the hollow-metal wall sections. Use of these diamond drills, as well as the use of other power tools generally, resulted in improved accuracy, efficiency and speed of installation.

Lighting arrangements vary slightly from floor to floor in accordance with tenant preference, but in no instance are illumination intensities less than 55 footcandles. And, in numerous places, these levels go up to 85-fc. Basic luminaire used for office lighting is a 2-by-4-ft 4-lamp 40-watt recessed unit with white plastic diffusion panel, these units being installed either singly or in continuous end-to-end runs of varying lengths and varying line-to-line spacings. Basic unit used in corridors is similar, except that it is a square 2-by-2-ft 4-lamp 20-watt fixture.

From this basic lighting plan, installations vary in both public and tenant areas to include some interesting luminous ceilings, lensed downlights, various cove treatments and (in the lobby) series of 18-in. and 5-ft circular ornamental coffers recessed into a silver-leaf coated ceiling.

Designed capacity of lighting feeders and switching equipment for tenant use was on the basis of 5 watts per sq ft, with increment power requirements added for such specific purposes as kitchens, IBM machines and the like.

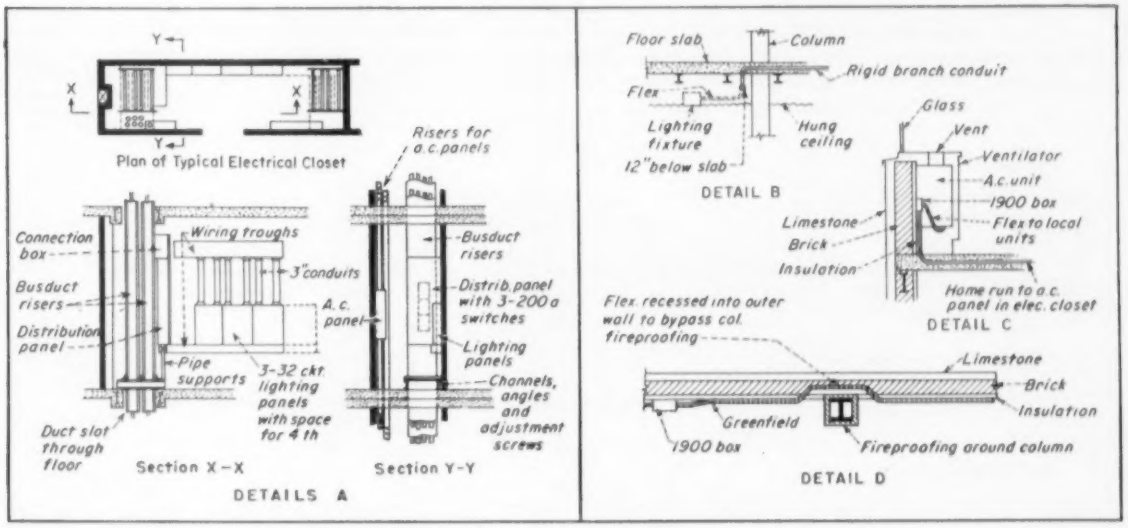
Remote Control

All public service equipment in the building (plus air conditioning and ventilating motors in tenant spaces) is controlled remotely as well as locally, thereby permitting the watch engineer to monitor and regulate key operations from a basement office. The remote control panel at this central location contains five 42-point terminal blocks for control wiring connections and is equipped with start and stop pushbuttons, plus indicating pilot lights. Controlled equipment includes the already-mentioned ventilation units, plus roof and basement fans, lobby exhaust and heating units, house pumps, freight and passenger elevators, etc.

Primary service at 13.2-kv (3-

BRANCH CIRCUIT conduits were positioned on floor forms prior to pouring of slabs, their alignment being insured by clipping them to reinforcing steel. Service for tenant space was generally at 120/208-volt level. Incidental power to open-floor areas was furnished by 4-in. round boxes recessed into slabs and bottom-fed from hung-ceiling space.

LOOKING UPWARDS through tier of electrical closets during construction shows bottom pullbox and conduit risers related to air conditioning system already in place. Busduct risers were subsesquently added in angle-formed framework; then floorslabs were installed prior to positioning and connection of distribution and lighting panels.



ELECTRICAL CLOSETS on lower floors contain four busduct risers, although these risers terminate on the 6th, 11th, 16th and 20th floors respectively. Busducts are supported at each floor level by channels and angles and are close-coupled to distribution panels which they serve.

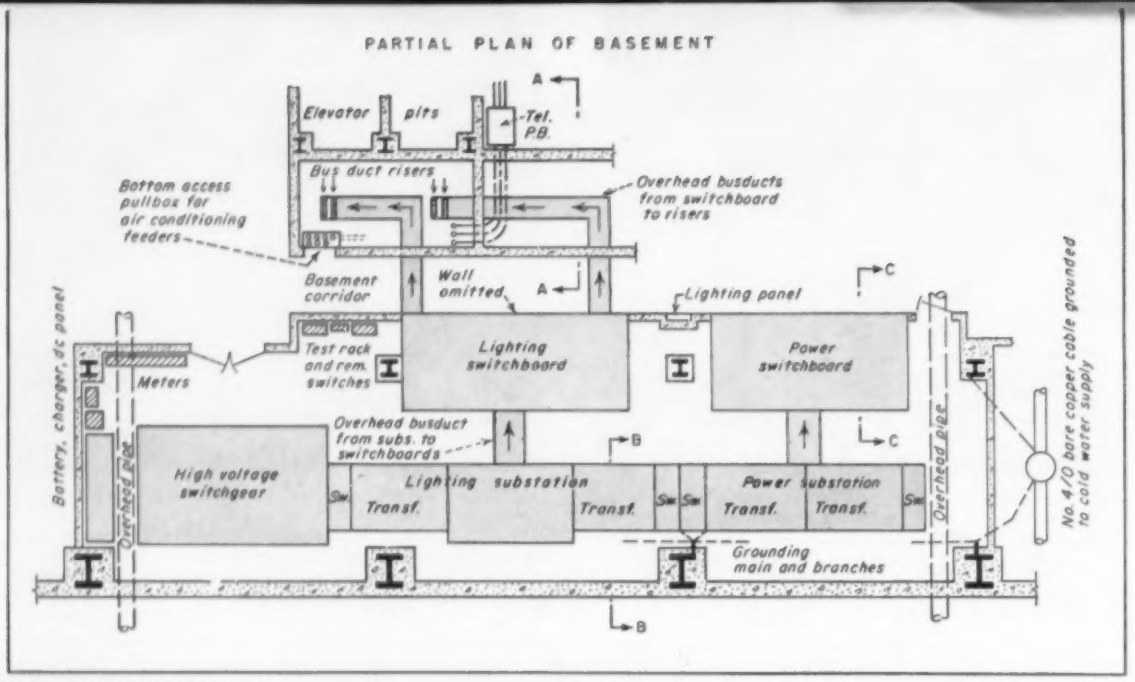
RIGID CONDUITS carrying lighting circuits are routed through upper slabs, then are stubbed down for flexible connections to fixtures. Feeders for air conditioning units are carried in lower slabs to midpoints of north and south walls, then are routed laterally along interior surfaces of parapet curtain walls.

phase 3-wire) is delivered to the building underground by utility-owned cables; each of two separate entrances (consisting of three 1/c 300MCM cables) connecting to two 1500-kva delta-wye open dry type transformers, one related to a double-ended 480/277-volt power substation, the other related to a similar sub for 120/208-volt lighting purposes. Services are cross-connected at the 13.2-kv level through a 1200-amp air circuit breaker that automatically closes in the event of an interruption of power on either primary, while secondary breakers in both substations are interlocked with primary air-filled interrupter switches to provide additional system protection.

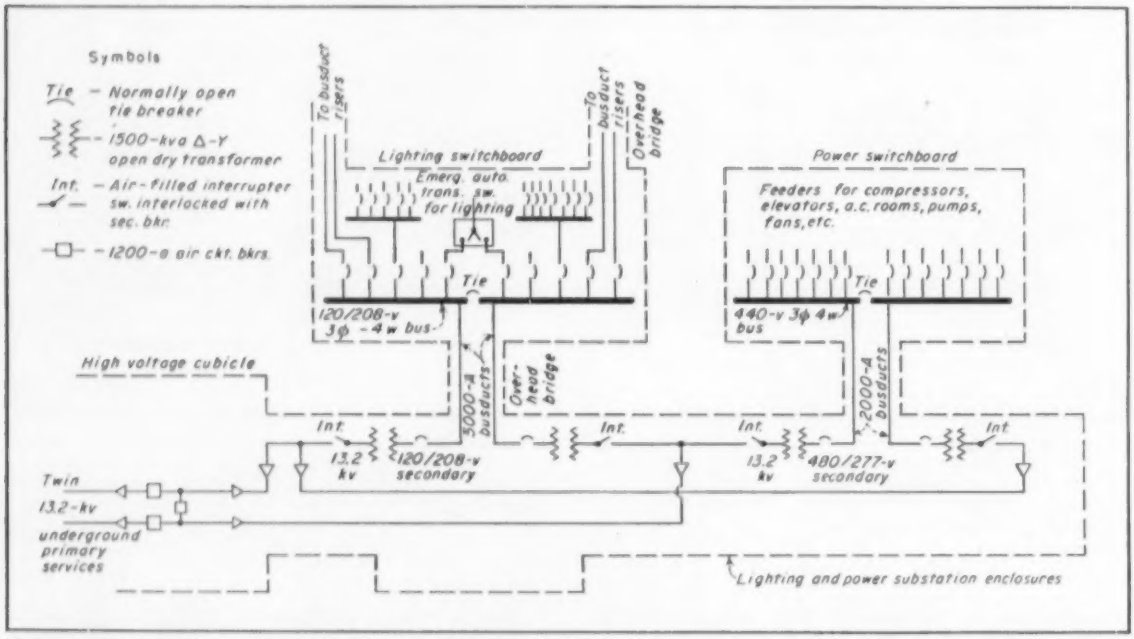
Secondaries of both substations are connected, via overhead ventilated bus ducts, to split bus structures in corresponding power (3-wire 440-volt) and lighting (4-wire 120/208-volt) switchboards, each of these split buses being linked through normally open manually operated tie breakers.

Feeders leading from low voltage breakers of the 440-volt switchboard serve air conditioning equipment, elevators and power centers, while feeders from the 120/208-volt board serve the four main vertical bus duct risers, large tenants on the lower floors, public lighting and all service areas. Feeders from both sections of the lighting switchboard bus structures also connect (through an automatic transfer switch) to an emergency lighting panel which is likewise served by a 50-kw lead-acid automatically charged dc battery.

Due to the (1) location of the substation and switchgear room,

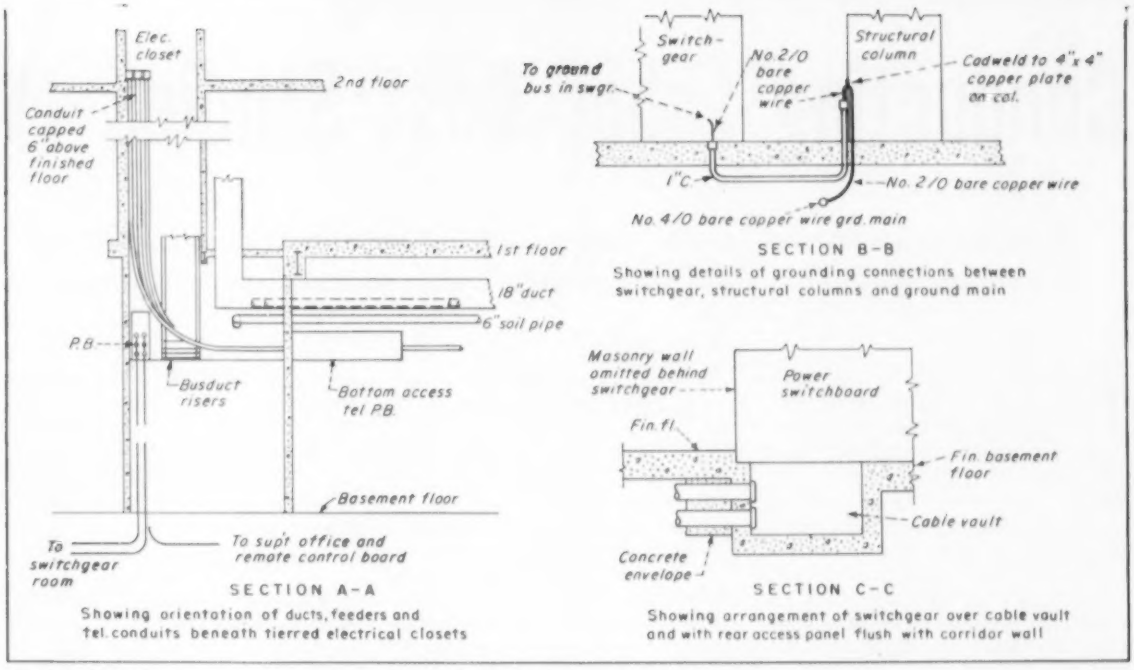


PRECISION WORKMANSHIP was required to align vault equipment. Wall of basement corridor was interrupted to permit rear access to switchboards. Overhead busduct was used to connect substations, switchboards and vertical distribution risers.

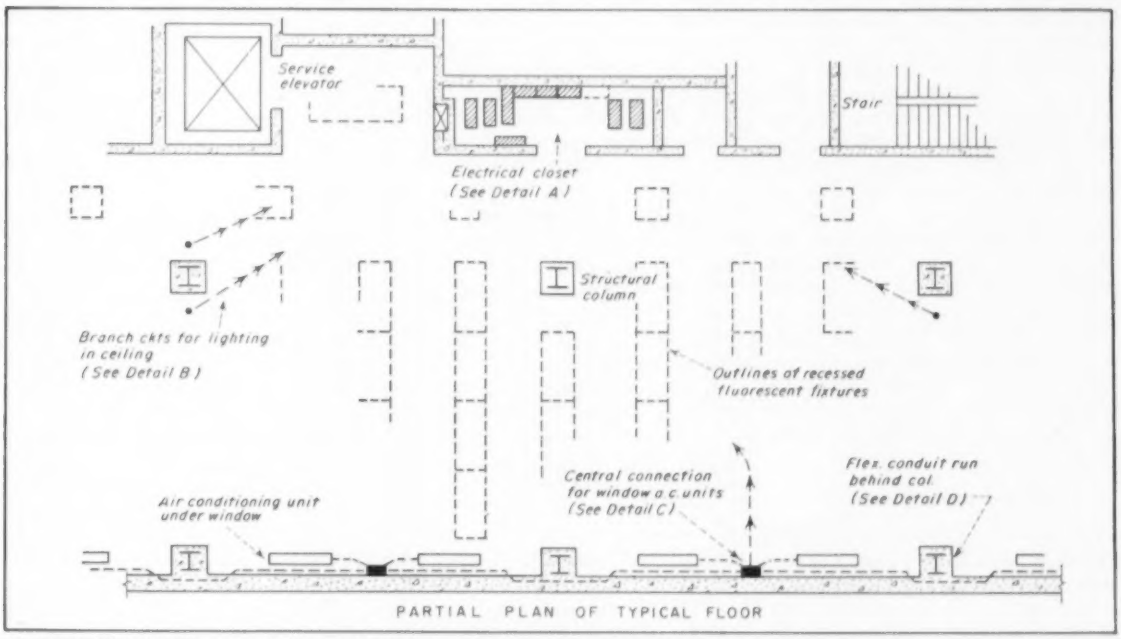


LINE DIAGRAM indicates arrangement of twin underground 13.2-kv services, transformers, bus assemblies, breakers, interrupting switches and automatic transfer for emergency lighting system. Dual service entrances plus tie breakers between buses insure continuity of electrical service.

(2) physical size of service equipment enclosures, (3) existence of columns, beams, ducts and piping related to other trades, and (4) offset alignment between the basement vault and the tier of electrical closets on upper floors, the installation of equipment demanded considerable precision work. For example, skidding the 9-ft-high high-voltage cubicles through entrances and passageways to the vault location was a shoe-horn operation requiring the use of small-diameter rods as rollers. Also exacting was the erection of the 64-ft-long substation assembly, for the location of columns and overhead pipes provided clearances of less than an inch at several points. In another instance the curtain wall of a basement passageway was snugly fitted around sections of the switchboard, so that the rear access panels of the cubicles would be flush with (and form part of) the corridor wall. And, finally, to orient bus and conduit risers beneath the vertical tier of upper-floor electrical closets, it was necessary to design and install numerous horizontal offsets for bus ducts, vertical sweeps for conduits, large bottom-



CROSS SECTIONS show orientation of risers beneath electrical closets; methods for grounding switchgear and structural columns; arrangement of switchboards relative to cable vaults beneath them; 2-level basement slab and finished wall line of corridor.



DISTRIBUTION PANEL on each floor is located directly in front of, and is connected to, the vertical busduct serving it. Ducts are supported at each floor level by channels that span duct slots, angles that are welded to perforated duct casings, and adjustable screws that are positioned between these supporting members at all intersection points.

or-side-access pull boxes, and concrete-sheathed conduits to underpass basement corridors.

In this sizable precision fit installation operation, the 15-kv switchgear was first split into sections at the ITE plant; all physical connections between frames were removed; sections were truck-loaded by industrial truck skids and unloaded at the job-site by rollers; then sections were shifted to the vault with the use of rod rollers, blocks and tackle. When finally positioned above cable troughs and upon slab-imbedded channel-iron base frames, sections were jacked for exact level and alignment, rebolted into a complete assembly and finally rechecked for proper connection and operation.

This building is impressive from standpoints of design and engineering, but it is also an example of progress paced to an achieved time schedule of "one year even, from ground-breaking to tenant-occupancy."

Electrical engineering was performed primarily by the Ortlip Company, with several major assists coming from ITE applications engineer David Honan.

Conducting Labor Cost Studies—V

Completed Job Studies, to avoid future pitfalls, are a must on all projects even if labor totals are below normal. Here's what such analyses may reveal.

By Ray Ashley
Research and Consulting Engineer
Oak Park, Ill.

THE most common form of labor cost study is the review of projects that have been completed. Such a study may range from a mere cursory examination of job records to a searching analysis of all job operations. Generally, there is a tendency to neglect the better jobs (those showing a good profit) and concentrate on those showing a loss. In such cases, the study too often develops into a "postmortem" for the purpose of establishing alibis to clear someone's conscience. The prime objective should be to ferret out the basic cause of labor variance as a prelude to action barring repetition on future jobs.

Projects that provide more than estimated gains should be analyzed just as carefully as those showing a loss. There is always a reason for jobs not coming out approximately as estimated. If there is assurance that the estimate was correct, the factors causing the variation should be uncovered. These same factors may be responsible later for losing good jobs or securing desirable ones. Let us explore some of the causes, besides estimating, for variation between estimated and on-the-job labor totals.

Why Excess Labor?

In good contracting practice, a tolerance of plus or minus 5% between estimated and required labor is acceptable. Variations of 10% justify attention. Such attention may reveal, among others, the following causes of labor excess:

1. Poor management by the electrical contractor.
   a. Poor selection of men for the work.
   b. Improper handling of supply of men on the job.
   c. Inadequate working drawings.
   d. Poor or inadequate construction engineering.
   e. Inadequate tools and job mechanization.
   f. Trying to push the job at the wiring time.
2. Quality of available mechanics below that anticipated.
3. Poor progress of other trades on the job.
4. Unpredicted weather conditions.
5. Bad material deliveries.

The above items have been discussed many times, but they bear repetition here to illustrate their value to labor cost studies.

When labor exceeds an anticipated figure, a review of the job activities may reveal one of the above or any one of a number of factors as contributory causes. A thorough study of this type may well enable the contractor to sidestep similar trouble on future projects. Small items, which seemed of little consequence while the job was in progress, may emerge as important factors under retrospective analysis.

Contractors are becoming more conscious of the value of good engineering, adequate tools and many other things supplied as a function of good management. The majority, however, seem to underestimate the costly "men on and off the job" practice. Taking men off a job for a few days and then sending them back can be very costly. Often it is necessary to have men to temporarily relieve the pressure on other jobs. When this is done, the greatest care should be taken in selecting the job to be penalized. Some projects may be able to stand a temporary reduction of manpower more economically than others.

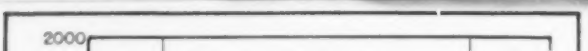
Trying to "push" jobs too fast can be serious and caution should be exercised. It is far better to have the job push the men than to have the men try to push the job. A project can go just so fast and there is nothing the mechanics can do to change the situation. Losses due to overmanned work are a fault of management and not the men on the job. Usually, the progress of other trades on the project is the governing factor.

Value of Labor Curves

Much can be learned by plotting manpower-demand curves and much can be gained by using some form of construction-period guide when assigning men to a specific project. Fig. 1 gives a schedule of the days and weeks representing the optimum duration for electrical projects of various sizes (taken from page 151, *Electrical Estimating*, First Edition, McGraw-Hill Book Co.). Overall project time is divided into six periods: (1) short duration preparation phase; (2) manpower buildup; (3), (4) peak manpower periods; (5) main dissolution period when electrical crews are pared; and (6) cleanup period. Prime goal is to maintain an orderly buildup and decline of manpower as anticipated in the original estimate. Perhaps the best way to accomplish this is to plot the anticipated manpower curve at the beginning of a project, then add the actual manpower demand curve as the job progresses. This provides a constant comparison over the duration of the project. The schedule in Fig. 1 provides an excellent guide for the study of completed job curves.

An additional refinement of job labor control study is the comparison bar-chart (Fig. 3) where actual labor is plotted daily, weekly or monthly (as desired) against estimated labor in specific installation categories. Such a chart is of considerable aid to the estimator and field supervisor and may provide many answers to questions which might arise during the completed job study.

What can happen when a project does not receive the supervision or



CONSTRUCTION PERIODS FOR ECONOMIC OPERATION OF ELECTRICAL INSTALLATION PROJECTS – INDUSTRIAL.

SEE NOTES BELOW

CONTRACT DATA						LABOR		CONSTRN PERIODS-SEE SKETCH BEL.									TOTAL PERIOD		AV NO. OF MEN EMPL.
SELL PRICE	BASE COSTS			JOB COSTS & MARKUP		MAN HOURS	MAN DAYS	1 & 6			2 & 5			4 & 3			DAYS	WKS.	
	MATERIAL	LABOR	L & M.	%L&M	DOLLARS			DAYS	MEN AV.	MAN DAYS	DAYS	MEN AV.	MAN DAYS	DAYS	MEN AV.	MAN DAYS			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
10,000	3,750	2,500	6,250	60.0	3,750	1,250	156	10	2	20	12	4	48	15	6	90	37	7.4	4.2
25,000	9,450	6,300	15,750	58.7	9,250	3,150	394	12	2	24	35	6	210	16	10	160	63	12.5	6.3
50,000	19,200	12,800	32,000	56.2	18,000	6,400	800	12	2	24	52	8	416	30	12	360	94	19.	8.5
100,000	40,800	27,200	68,000	47.7	32,000	13,600	1700	15	4	60	75	12	900	37	20	740	127	25.4	13.4
200,000	84,000	56,000	140,000	42.9	60,000	28,000	3,500	20	4	80	125	16	2,000	60	24	1,440	205	41	17.1
300,000	132,000	88,000	220,000	36.5	80,000	44,000	5,500	30	5	150	145	22	3,190	60	36	2160	235	47	23.4
400,000	178,500	119,000	297,500	34.5	102,500	59,500	7,440	30	5	150	160	26	4,160	70	45	3,150	265	53	28.5
500,000	225,000	150,000	375,000	33.3	125,000	75,000	9,375	35	5	175	175	30	5,250	75	53	3,975	285	57	33.
600,000	270,000	180,000	450,000	33.3	150,000	90,000	11,250	40	5	200	185	34	6,290	80	60	4,800	305	61	37.
750,000	337,000	225,000	562,000	33.3	187,500	112,500	14,060	42	7	294	225	37	8,325	85	64	5,440	350	70	40.
1,000,000	450,000	300,000	750,000	33.3	250,000	150,000	18,750	45	11	495	270	45	12,150	85	72	6,120	400	80	47.
1,250,000	570,000	380,000	950,000	31.7	300,000	190,000	23,750	50	14	700	295	54	15,930	90	80	7,200	435	87	54.5
1,500,000	680,000	460,000	1,140,000	31.6	360,000	230,000	28,750	60	15	900	300	66	19,800	90	90	8,100	450	90	64.
1,750,000	801,000	534,000	1,335,000	31.0	415,000	267,000	33,375	65	16	1,040	304	72	21,888	95	110	10,450	465	93	72.
2,000,000	915,000	610,000	1,525,000	31.0	475,000	305,000	38,125	70	18	1,260	310	79	24,490	100	125	12,500	480	96	80.

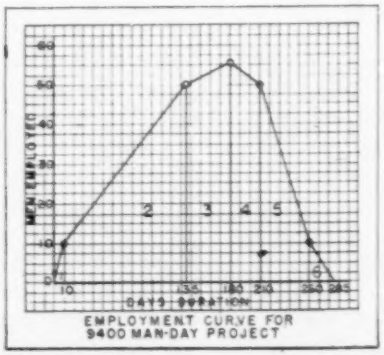
NOTES-CALC.& BASE FIGS.:-

1- AS FIGS. ARE ONLY APPROX., MINOR IRREGULARITIES HAVE NOT BEEN IRONED OUT.

2- BASE FIGURES- A-"60/40" PROJECTS (MAT. 60%-LAB. 40%). B-LAB RATE $2.00/HR. C-5 DAY WEEK. D-INS. & EMPL. BENEFITS=14.5%. E-ENG., SUPERVISION, TOOLS, INSURANCES, ETC. INCLUDED IN JOB COSTS.

3- PERIODS FOR CONSTRUCTION TIME BASED ON PROGRESS FREE OF INTERFERENCE FROM OTHER TRADES AND OPERATIONS.

4- CONTRACTORS, MANNED, EQUIPPED, AND ORGANIZED TO EXPEDITIOUSLY CARRY ON THE WORK.



EMPLOYMENT CURVE FOR 9400 MAN-DAY PROJECT

ESTIMATED OPTIMUM DURATION FOR A JOB REQUIRING 9400 MAN-DAYS (SEE $500,000 PROJECT)

PERIOD	DAYS	NO. OF MEN-AV.	MAN DAYS
1	10	5	50
2	125	30	3750
3	45	53	2385
4	30	53	1590
5	50	30	1500
6	25	5	125
TOTALS	285		9400

ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO

FIG. 1—MINIMUM LABOR COSTS are experienced on jobs that closely follow the optimum duration curves. Tables above are useful in analyzing plotted labor curves for completed jobs, and provide a good guide for job labor control.

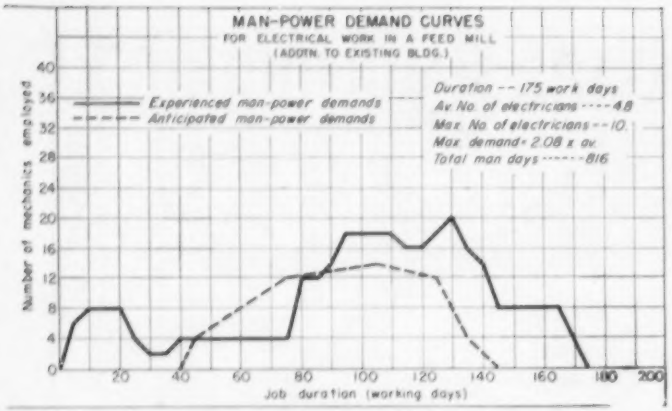


FIG. 2—MANPOWER-DEMAND CURVES are an excellent aid to completed job labor study. This one tells a poignant story of initial overmanning and lack of supervision. Note difference between anticipated and actual labor throughout job duration.

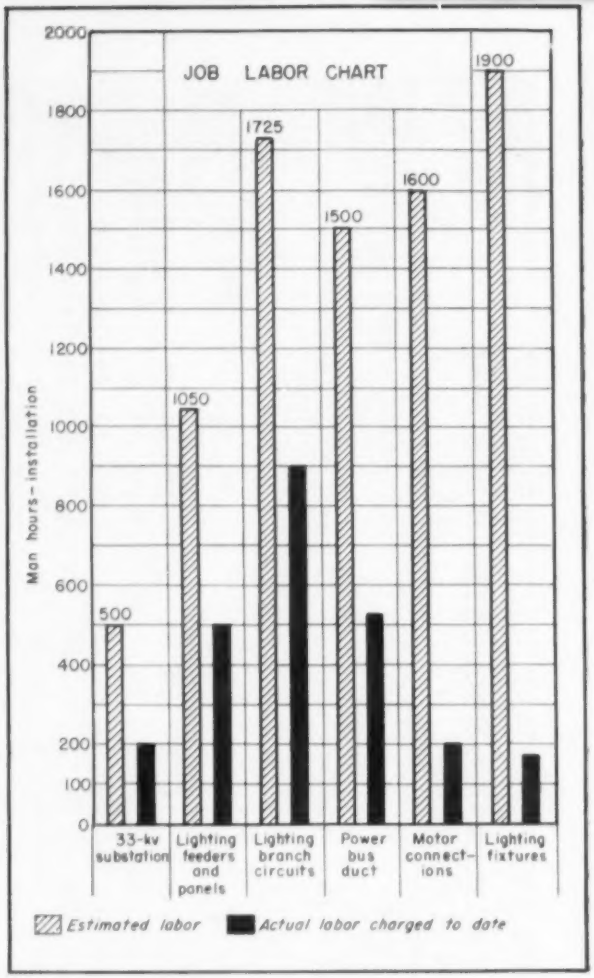


FIG. 3—COMPARISON BAR-CHART is a simple way to keep tabs on expended labor as job progresses. This one plots actual against estimated labor in specific installation categories. Black bars can be extended daily, weekly or monthly as desired.

attention it warrants is graphically shown in Fig. 2 (page 59, EC&M, Dec. 1951). This job was practically completed before the contractor realized that neglect and too many men on the job had wrecked his estimated cost. The final job reports prompted plotting the manpower curve and the results told a fairly poignant story. Too many men were on the job at the beginning (probably at the insistence of the architect or owner) with not enough work ready to keep them busy. Lack of attention on the part of the contractor permitted the overmanned condition to exist too long. Unfortunately, the labor curve was drawn too late to do any good on this specific project, but it did alert the contractor to watch this on future jobs.

Costs Below Normal

Contracts that show unusual savings in labor should be studied as thoroughly as those revealing excess labor. The cause may have been an unusual condition or the estimate may have been too high. Unless a contractor studies these projects too, he may end up pricing himself out of good work when it is sorely needed.

We cannot always finger any one thing as being responsible for excessive savings. This "happy" condition cannot always be treated as signal to start lowering prices for the particular type of work. Such savings must be verified by other studies and thoroughly analyzed before taking this step.

Firms often get good contracts when work is at a low ebb and a crew of better quality mechanics can take over. The job shows a marked saving on labor. The same job, if taken during an overloaded period and placed in the hands of below-average mechanics, might have shown a substantial loss.

Job Study Benefits

The advantages of conducting and analyzing completed job studies should be apparent from the examples noted. A number have been listed, others implied. Some have been noted in previous articles as accruing from specific studies explored. To these we might add the following:

1. General contractors and architects and engineers can be appraised and rated as to the desirability of their work.

2. The willingness to cooperate of various sub-contractors on projects can be noted and filed for future reference.

3. Approximate costs of material procurement failures (materials by others) can be learned and used to advantage in future estimating.

4. Peculiarities and factors for determining the desirability of special types of work can be better appreciated.

5. Management mistakes can be detected and corrected.

Exact benefits of all time studies are more or less intangible, but we cannot deny that such studies are an essential part of the electrical construction industry. Not only does the contractor benefit, but the buyer as well. With the increased installation efficiency comes lower labor costs which invariably are reflected in contract bid prices.

The concluding article of this series will present a case-study answer to how much labor costs vary.

PLASTIC CONDUIT

for substation control

Underground butyrate plastic conduit connecting substation equipment with control room at Edward F. Barrett Power Station, Long Island, N. Y., is expected to protect control cables from damage due to excessive settling of the earth. Circuits will enable substation equipment to be operated remotely from control room.

1 **CONDUIT** was installed at bottom of 3-ft-deep trench without support. Piling, necessitated by marshland site for support of manholes, would also have been required for concrete-enclosed rigid conduit to prevent settling and cracking of concrete with subsequent damage to conduit and cables. The flexible plastic, which will follow the ground movements without fracturing, eliminated costly piling and concrete work. (Top)

2 **BELLED ENDS** of conduit in manholes reduce abrasion and facilitate cable pulling. Cable will pass through two intermediate manholes and terminate in manhole at outdoor equipment, a total run of 550 ft. Conduit inside diameter is 3 in., wall thickness ¼ in. (Center)

3 **SLEEVE** was used to join conduit with asbestos-cement duct at control room. Duct was scored around its circumference with a file, creating a ¼ in.-deep channel. Sleeve was fitted to the conduit, ends butted and cemented, and the sleeve slipped over the joint. The cement-filled channel provided mechanical locking as well as permanent sealing. Joining of plastic lengths was identical, except that the channel was unnecessary. (Bottom left)

4 **RIGHT-ANGLE BEND** was made, several lengths were joined, and the resulting assembly was laid on the ground along the proposed route. The ground was marked, using the conduit as a guide, to indicate the path of the trench. The conduit was moved to one side while trench was being dug by power crane; conduit was then pushed into trench. Installation was by Arc Electrical Construction Co., Inc., New York. (Bottom right)

STERLING AND FRANCINE CLARK ART INSTITUTE in Williamstown, Mass., merits praise for quality lighting plan, automatic electrical controls, scope of protective devices and architectural beauty.

LIGHTING AND PROTECTION

. . . FOR AN ART MUSEUM

Outstanding electrical installation in privately-endowed art institute features wide variety of dimmer-controlled illumination treatments, photocell-activated motorized skylight louvers plus dozens of automatic operational devices related to fire and theft protection, temperature and humidity conditioning.

By Hugh P. Scott

ONE of the most beautiful art museums to be found in this country is located in Williamstown, Mass., where work on the Sterling and Francine Clark Art Institute has just been completed.

Designed along classic lines; graced by broad steps leading up to a pillared portico; sheathed completely in white marble and placed in a setting of broad lawns and stately trees, this impressive privately-endowed building justifies the use of superlatives.

Therefore, if *beauty* were the only requisite for judging a museum, little more could be desired. Beauty is only one of *several* judging standards, however. Another one is *protection*.

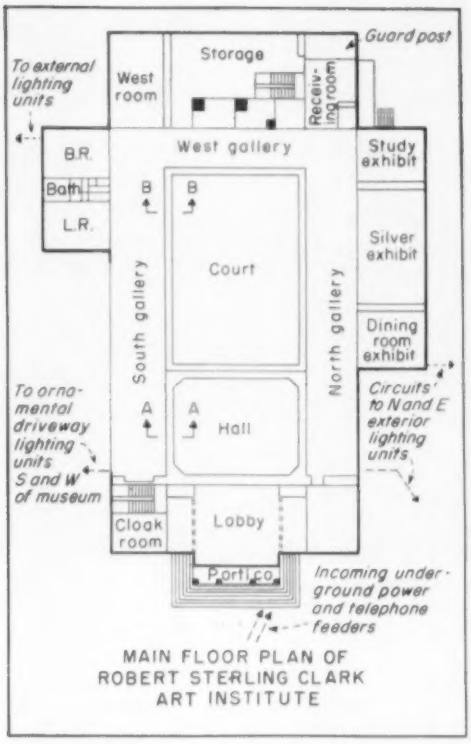
Protection is actually a *multiple* objective, because works of art must be protected against fire and theft; paintings should be safeguarded against fading, and canvases should be protected against shrinking or stretching.

In the Clark Institute, all of these requirements are satisfied: the majority of them electrically. For example; photo-electric cells detect the presence of smoke in air ducts or plenum chambers, alerting watchmen to the fact through mediums of an alarm and location annunciator. Door switches at all entrances activate a gong at the Guard Post whenever a door is opened or closed. And, in the event that a watchman is detained on his periodic inspection trips (and therefore does not complete his rounds within a predetermined interval), this fact will be broadcast to local police by a clock-controlled alarm on the museum's roof.

Another insurance medium against damage by fire is provided in the form of a segregated vault (equipped with explosion-proof luminaires and switches) in which inflammable materials are stored. And, to protect works of art while they are not on display, a second vault (equipped with a bank door and emergency lighting) is located centrally in the museum's basement.

To preserve canvases, both temperature and humidity are closely regulated in connection with the distribution of completely conditioned and filtered air. And, to minimize either gain or loss of either heat or moisture, all exterior walls of the building incorporate vapor sealing and blanket insulation.

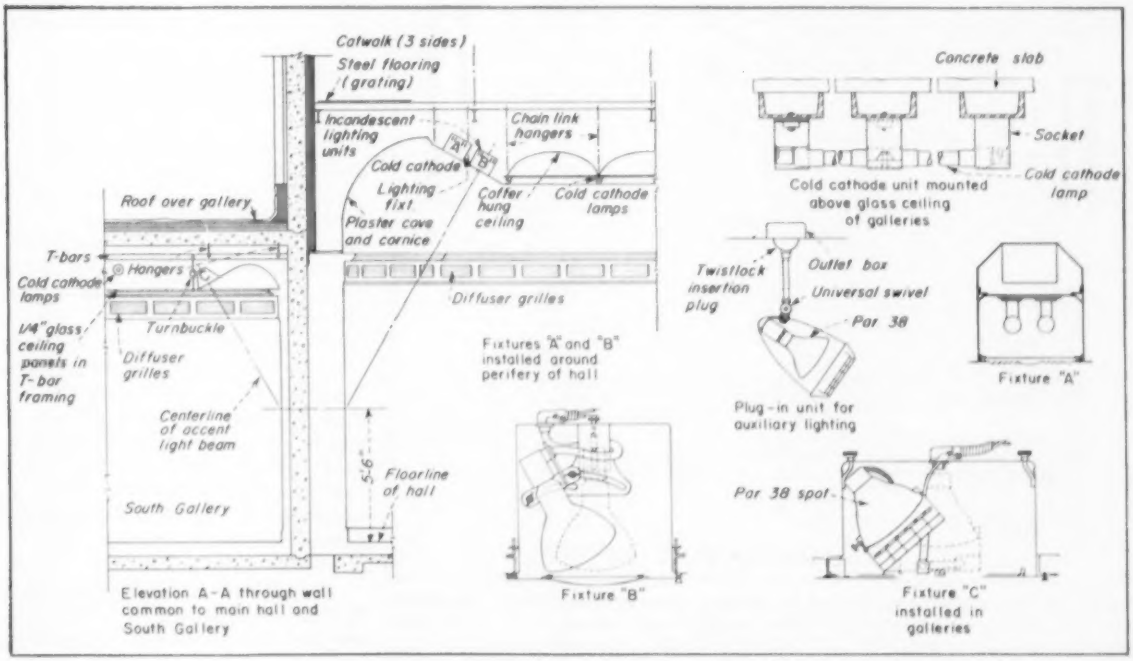
Finally, to protect paintings against fading from direct sunlight, two tiers of photocell-activated motorized louvers are positioned between the building's expansive wire-glass roof and a translucent glass ceiling which is suspended above the museum's central exhibi-

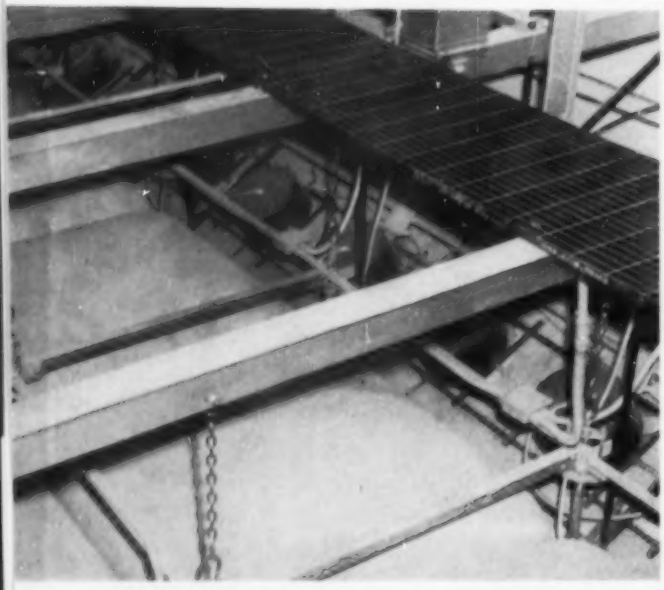


PLAN SHOWS ARRANGEMENT of central hall and court flanked by galleries and special exhibition rooms.

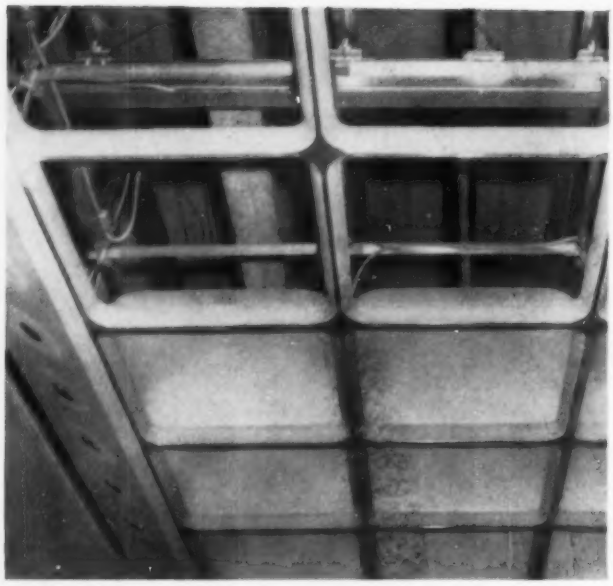
GENERAL ILLUMINATION in exhibition hall is indirect; square ceiling coffers reflecting light from grid of shielded cold-cathode lamps.

ELEVATION INDICATES variety of direct and indirect lighting treatments used in main hall and side galleries of the Clark Art Institute.

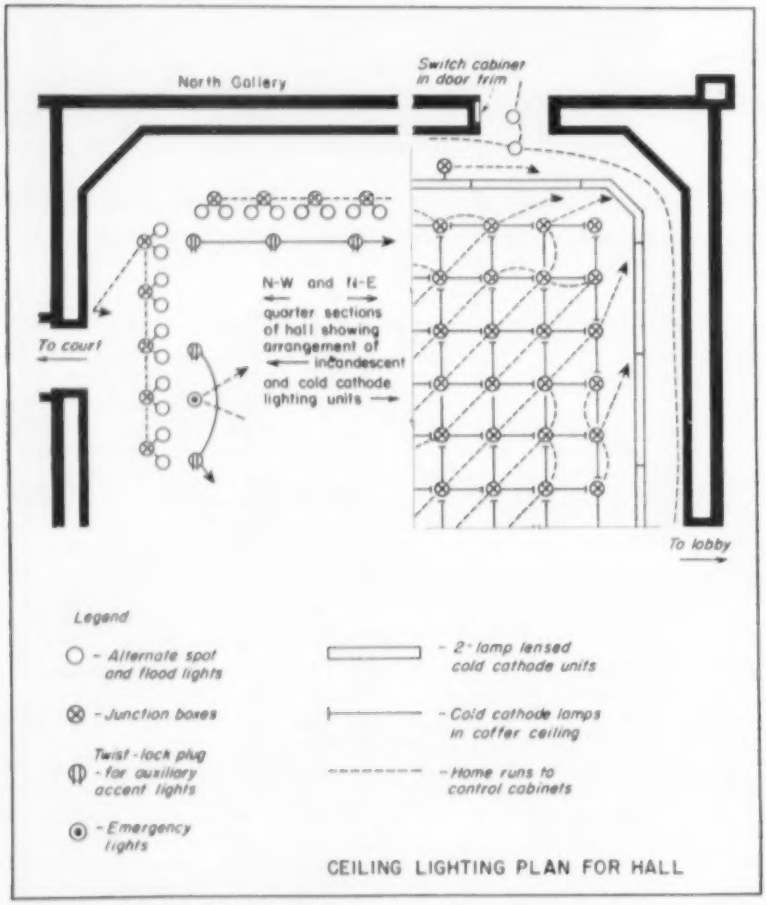




COFFER-TROFFER CEILING is chain-suspended from framework that also supports maintenance catwalks adjacent to border downlighting units.



COLD CATHODE LAMPS, shielded from view by reflector grid members, are flexibly connected to rigid branch conduit system located above coffers.



SECTIONS OF CEILING LIGHTING plan show arrangement, circuiting and control provisions related to cold-cathode coffer ceiling, lensed border fixtures, recessed spotlights, emergency lights and plug-in outlets for auxiliary units.

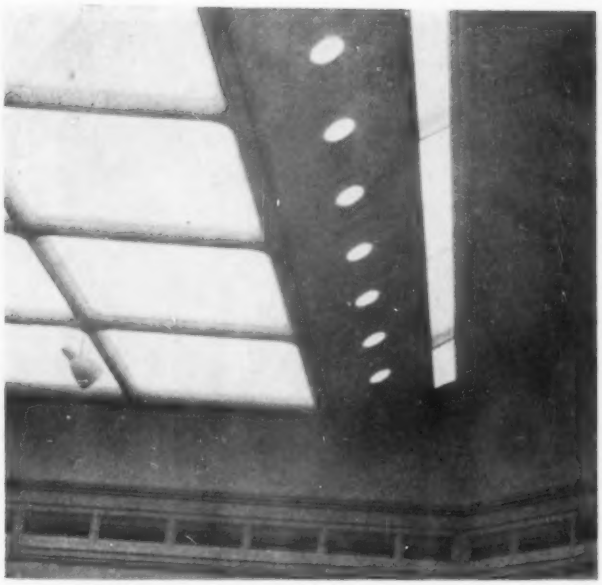
tion court. These two tiers of louvers—referred to as "ventilighters"—are installed at right angles to each other to insure thorough shielding from the sun's rays, and they automatically open or close as the sun moves daily from east to west or plays hide-and-seek behind clouds.

So, if the only two requisites for a museum were *beauty* and *protection,* this structure would again rate high praise. However, a *third* criterion also exists. That is good *lighting.*

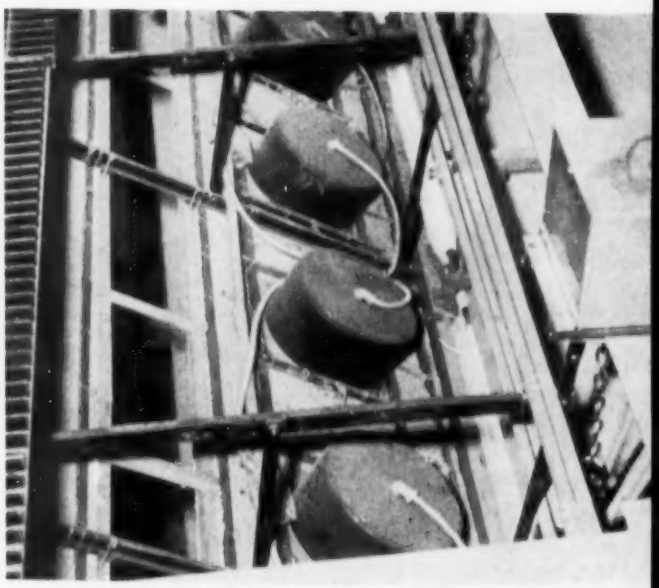
Quality Illumination

Here again the Clark Institute merits the citation of "outstanding," for incandescent and fluorescent light sources are combined with numerous remote switching arrangements and banks of dimmers to provide a wide variety of illumination possibilities. These possibilities are obtained by such means as indirectly-lighted coffers, back-lighted luminous ceilings, attractive cove treatments, recessed lensed and shielded downlights, reflector floods and spots, beautiful chandeliers and numerous other approaches—ornamental as well as functional—providing quality illumination.

That means that, by all three museum-judging standards — beauty, protection and lighting—



RECESSED BORDER LIGHTING treatment combines continuous rows of 2-lamp slimline lensed units with alternately placed spot- and floodlights.



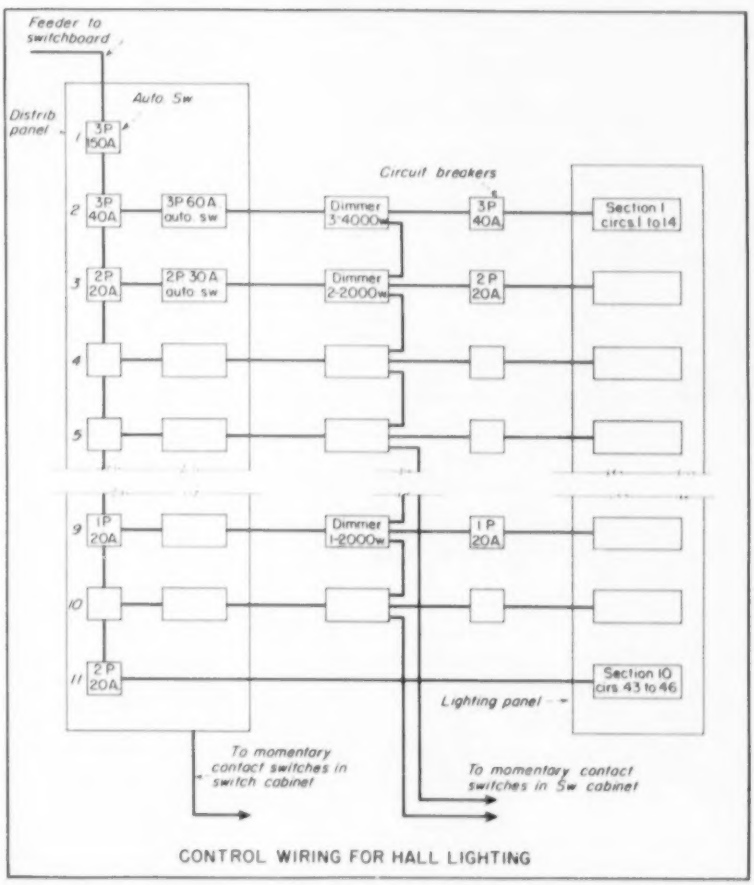
INCLINATION OF LAMPS in incandescent accent fixtures focuses light beams on walls of exhibition hall at normal eye level, 5½ ft above floor.

this building deserves high praise; reflecting credit upon architect Daniel Perry of Port Jefferson, N. Y.; consultants Meyer, Strong and Jones of New York City, and upon the Hixon Electric Company of Boston, Mass.

Coffer-Troffer Combination

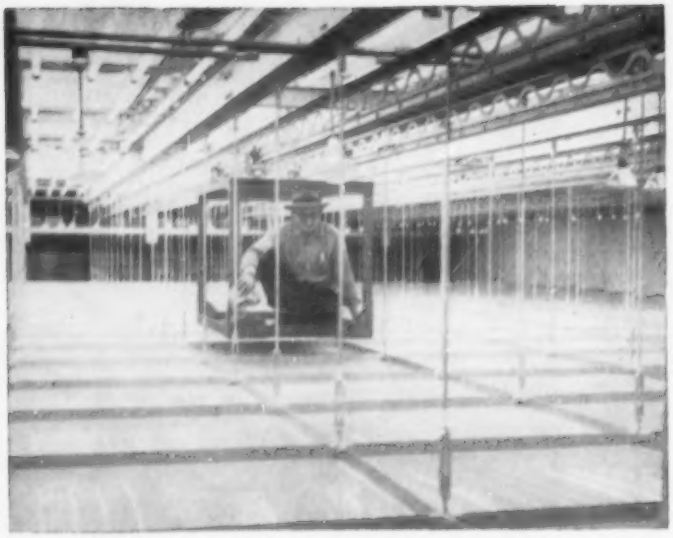
When studied in detail, each separate room presents comment-provoking electrical features. For example, general illumination in the museum hall is provided by means of a coffer-troffer ceiling. Coffers (approximately 4 ft sq) totalling 63 in number (9 rows of 7 units each) are chain-suspended from an overhead angle-iron framework that also supports catwalks to facilitate adjustment, inspection and maintenance. Intersections of coffers are shielded from below by a trough grid; troughs also serving as upward reflectors for T6 slimline lamps that illuminate the arched coffers evenly.

These lamps operate at 200-ma; related high-power-factor transformers being housed along overhead catwalks in ventilated steel cabinets on sound-and-vibration-dampening insulators; and transformers being interlocked with their respective enclosure doors so that automatic power cutoff occurs when cabinets are opened for inspection or maintenance.

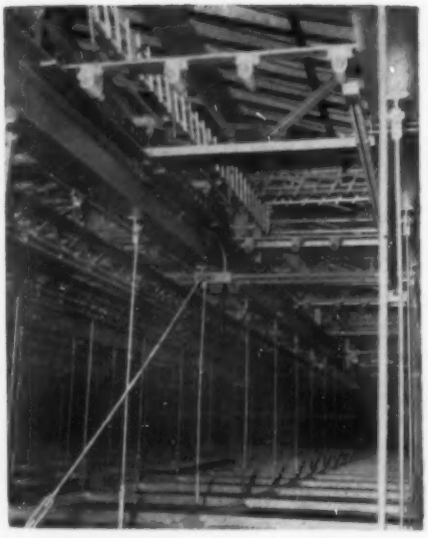


CONTROL WIRING FOR HALL LIGHTING

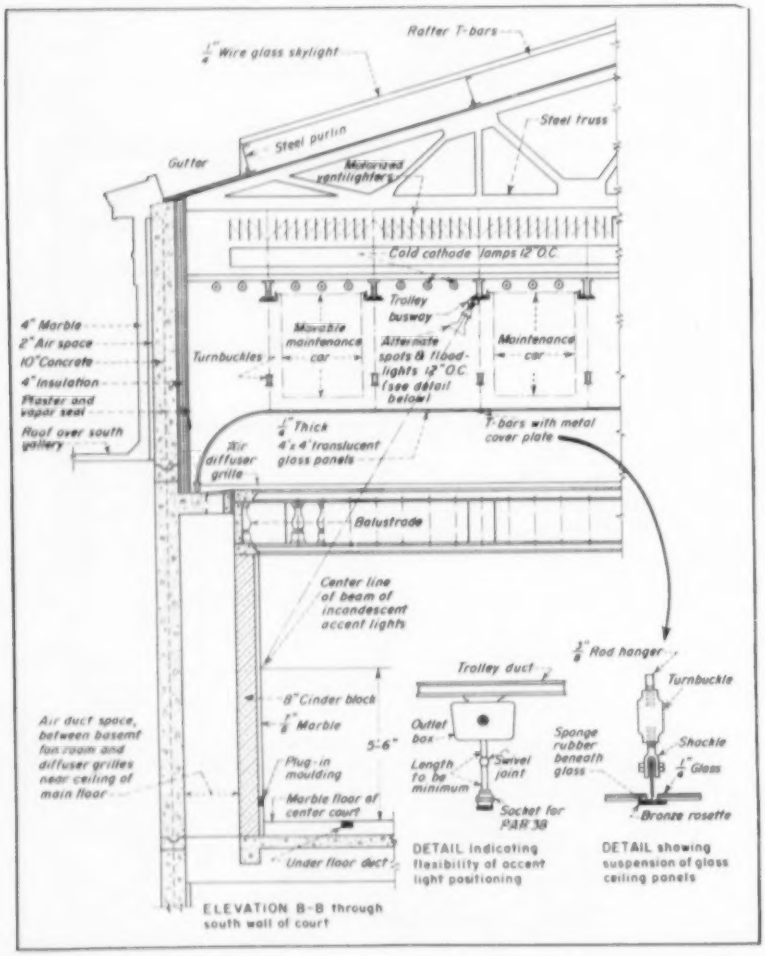
CONTROL OF LIGHTING in museum hall (typical, except for scope, of all exhibition areas) combines distribution and control panels, dimmers, breakers, automatic and remote momentary-contact switches.



MAINTENANCE CAR rolls along overhead tracks located above translucent ceiling panels, facilitating cleaning, relamping and adjustments.



LATTICE FRAMES of "ventilighters" are placed above cold cathode lamps.

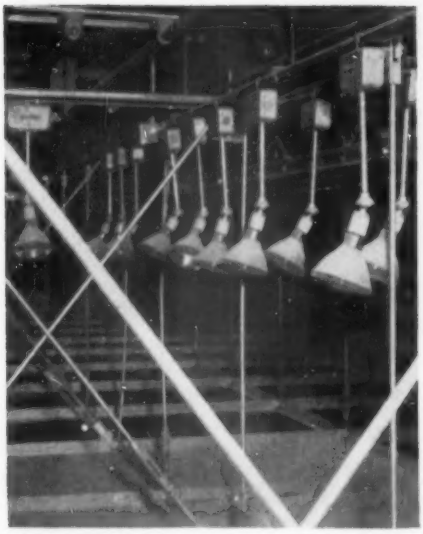


ELEVATION THROUGH COURT shows arrangement of suspended translucent ceiling, cold-cathode lighting system, accent lights on trolley ducts, "ventilighters" beneath skylight, air diffusion grilles, plug-in baseboard moulding and underfloor ducts.

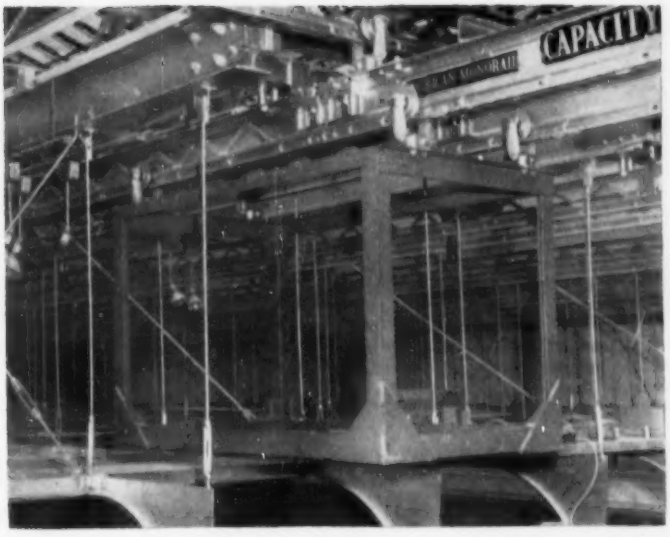
Ceiling brightness is regulated by a group of remotely-located motor-driven 2000- and 4000-watt auto-transformer dimmers controlled by momentary-contact switches. These dimmers relate to 12 separate circuits; circuits being connected through jack-and-plug connections and, collectively, including 142 cold-cathode lamps. Dimmers, equipped with automatic stops which may be adjusted for desired light levels, have automatic full-voltage restoration features that reset dimmers for full brightness each time current is interrupted.

Surrounding this central coffer-troffer ceiling area on all sides are two outwardly-inclined rows of periphery accent lights—the outer or upper row consisting of continuously-mounted recessed cold cathode 2-lamp fixtures shielded by longitudinally-lensed glass panels, and the inner row consisting of recessed 150-watt incandescent reflector spot and flood lamps alternately positioned at 2-ft intervals. These PAR lamps are adjusted in azimuth so that center lines of light beams impinge on walls 5½ ft above floor level—i.e., the elevation selected as the focal center of paintings being displayed.

In all, these two periphery lighting treatments combine 18, 8-ft 2-lamp cold cathode fixtures with 64 PAR-38 lamps, grouped on 16 circuits which (like the central coffer installation) are also dimmer controlled.



SPOTLIGHTS with individual outlet boxes can be shifted along trolley ducts.



SHIFTING OF MAINTENANCE CAR from track to track is accomplished through use of bridge crane which can be interlocked and moved as desired.

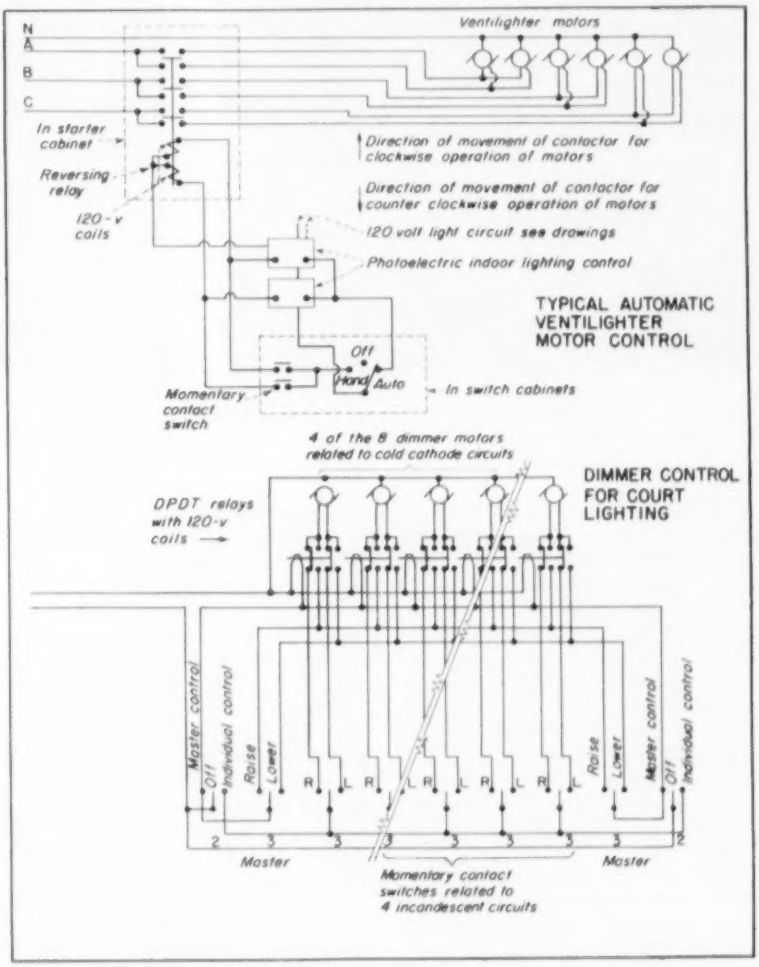
For highlighting free-standing exhibits in the central floor area, additional swivelling louvered luminaires equipped with reflector spotlamps may be plugged into strategically-placed twist-lock receptacles located at 16 different intersection points of the central overhead trough grid. And, at several other trough-intersection points, emergency lights (controlled by an automatic transfer switch) are also provided for anti-panic purposes.

Electrical service (for auxiliary floor-based lighting effects or for 120-volt maintenance tools) is provided by means of plug-in moulding installed continuously along all baseboards, while an underfloor fiber-duct installation provides additional outlets at 2-ft intervals along the longitudinal centerline of the hall floor.

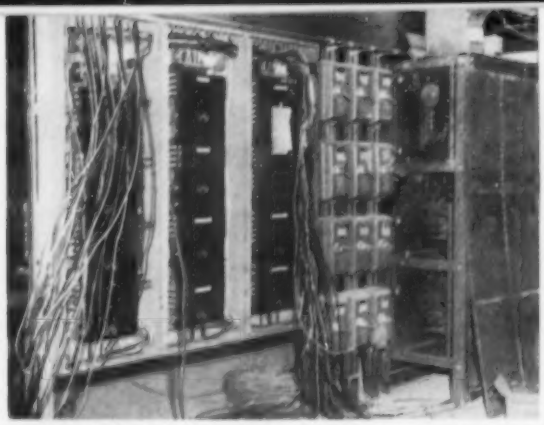
Translucent Ceiling

General illumination for the main exhibition court is provided by 160, 8-ft cold-cathode lamps mounted end-to-end, rows of lamps being spaced approximately 1-ft on centers, 4½ ft above suspended translucent ceiling panels. As in the hall, these cold-cathode lamps operate at 200-ma and are controlled through motor-driven dimmers (26 4000-watt units in all, arranged in 12 banks) by remote momentary-contact switches.

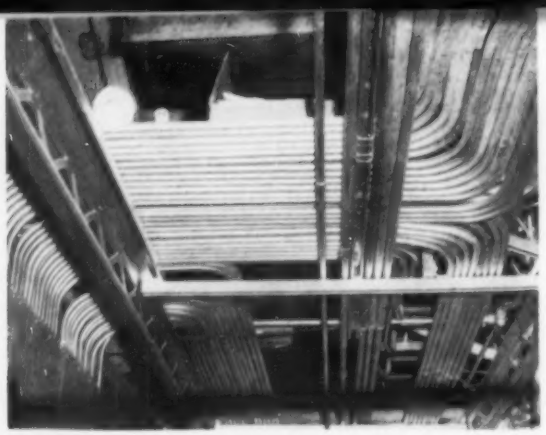
The suspended ceiling is formed by 216, 4-ft-sq ¼-in.-thick tempered-glass panels supported by a frame-



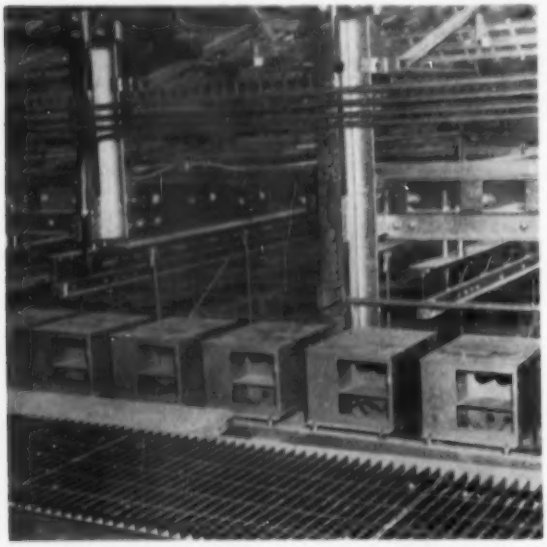
MOMENTARY CONTACT SWITCHES and remote relays are used to open or close motor-operated "ventilighters" and to raise or lower intensities of dimmer-controlled cold-cathode lighting systems. Photoelectric cells are similarly employed.



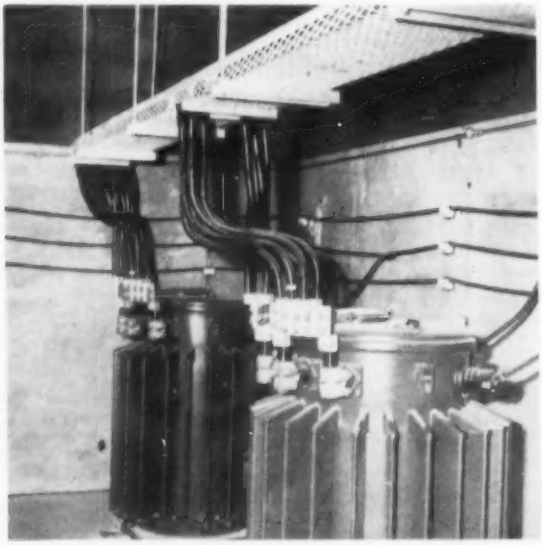
LIGHTING CONTROL PANELS, circuit breakers and dimmers related to exhibition court are located adjacent to and level with translucent suspended ceiling, thereby permitting lighting effects to be observed as they are initiated.



CONDUITS for 136 branch circuits fan out from back of 12-section mezzanine-based court-lighting control board. Lighting, operating through 26 4000-watt dimmers, is regulated by momentary contactors.



HIGH P-F TRANSFORMERS related to cold cathode lighting installations are housed in ventilated cabinets and are supported on insulators to minimize vibration and hum.



OVERHEAD METAL TROUGH carries feeders from transformer vault to main switchboard. Vault is protected against fire by automatic carbon-dioxide extinguishing system.

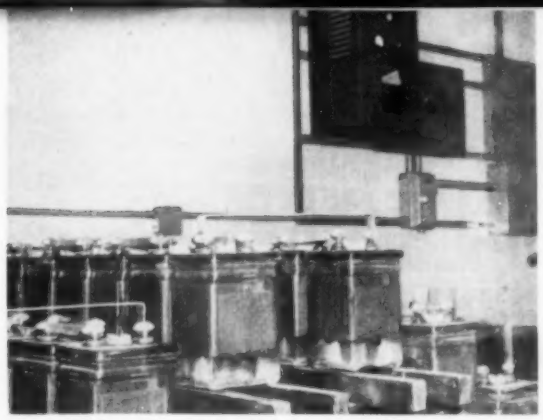
work of inverted T-bars. Lips of T-bars are edged with strips of white sponge rubber to insure panels against nicking or vibration, and the T-bar framework is suspended and leveled by means of hanger rods and turnbuckles.

As previously mentioned, cold-cathode lamps in this section of the museum are surmounted by a double tier of "ventilighters" designed to exclude direct sunlight from the exhibition area. These louvers (consisting of 7-in. wide fiberglas sheets in steel lattice frames) are on 4½-in. centers and can rotate within a 115-degree arc. Counterbalanced and pivoting on oil-impregnated porous-bronze bearings, these motor-operated units can be controlled either automatically by means of two photoelectric activators (one photocell for opening; one for closing), or by means of relays and remote momentary-pressure contactors. Of these two operational means, manual takes preference over automatic; contactors being interlocked to prevent the two controls from operating simultaneously in opposition.

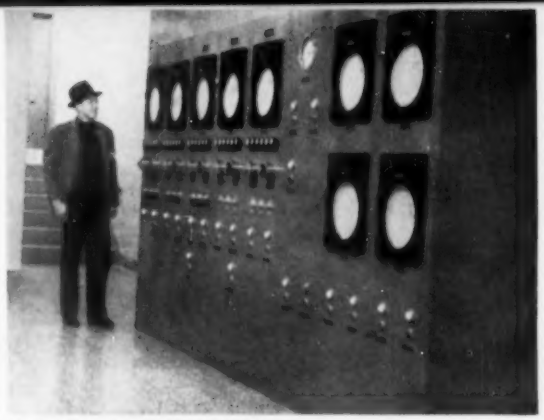
For highlighting paintings hung on walls of the court, this general illumination is augmented by 240 PAR-38 floodlamps; each lamp mounted in a swivel socket to a separate, movable outlet box riding along grooves of trolley-duct.

Another interesting feature to be found in this area above the court's 3500-sq-ft suspended ceiling is the presence of a movable maintenance car. This car, having a 3-by-5-ft working platform, is suspended by rollers riding along lower flanges of twin track beams that extend the length of the ceiling on 8-ft centers. Shifting of the car from track to track is accomplished by means of a transfer bridge-crane located just west of the translucent ceiling and at right angles to the six tracks. Interlocks for joining tracks to the bridge-crane, plus limit stops that automatically set when the bridge is moved, combine to insure track alignment during transfer and to prevent the car from running off the end of an unguarded rail beam. Movement of the car is easily motivated, manually, by the worker on the platform, and a maintenance man can thereby reach any lamp or piece of equipment in the area.

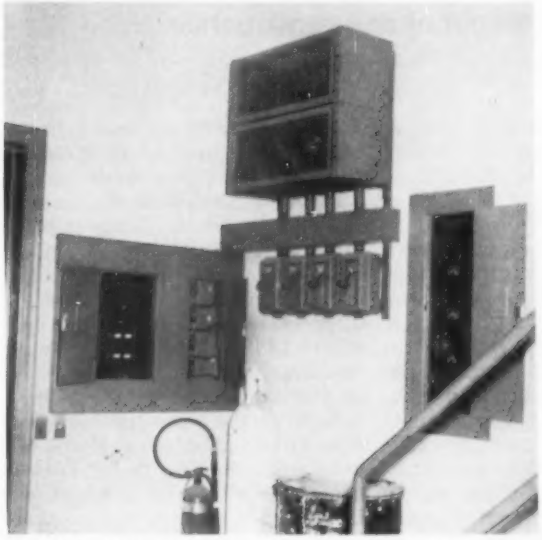
Other features of this installation include:



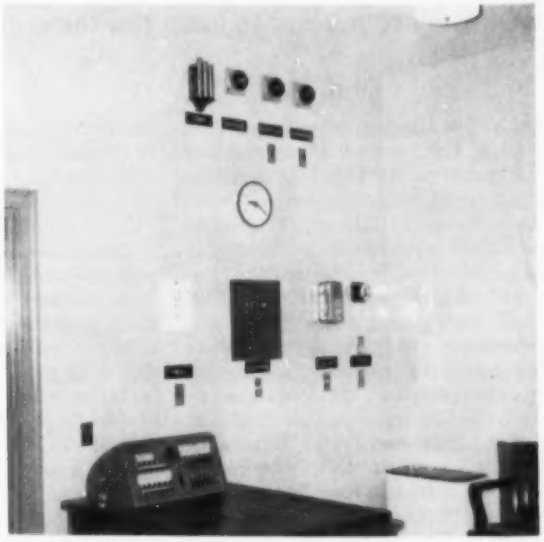
LEAD-ACID 60-cell battery for emergency dc lighting is automatically charged by selenium-rectifier unit and is automatically placed in service by transfer switch whenever normal ac power is interrupted.



CENTRAL CONTROL PANEL for heating, ventilating and cooling systems combines temperature recording gauges (outside and inside air; chilled water and condensate), plus push-buttons and pilot lights related to all motors in building.



TYPICAL CONTROL CENTER for gallery lighting has compact arrangement of automatic switches, a dozen 2000-watt dimmers and a 28-circuit control panel.



GUARD POST is equipped with public-address and telephone control cabinets, smoke detection annunciator, time switch for outdoor lights, plus timer for watchman's warning siren.

(1) A 60-cell lead-and-acid battery for emergency lighting, capable of supplying 5-kw of current at 105 volts or better for 1½ hours, complete with automatic charger;

(2) An automatic transfer switch to cut in the dc emergency lighting system should normal ac power supply be interrupted;

(3) An additional emergency service potential in the form of a manually-closed bypass around the main breaker to the utility feeder on the street side;

(4) A carbon-dioxide fire-extinguisher system in the transformer vault, set in operation in the event of a sudden heat rise;

(5) Nine exterior underground circuits serving ornamental lighting units located along walks, driveways and parking areas;

(6) A ceiling-suspended metal-mesh trough supporting 500MCM feeders between transformers and the main switchboard;

(7) Electric-pneumatic remote control for manually or automatically activating ventilation, heating and dehumidification systems;

(8) An astronomical time switch for automatically switching exterior lighting units on and off at predetermined times;

(9) Lightning protection in the form of ground-driven copperweld rods, with rising bare conductors welded to roof trusses and copper roofing;

(10) A modern circuit-breaker switchboard, sectionally divided for power and light, with separate P and L buses silver-plated at all joint and contact points;

(11) A 20-station call-and-talk-back public address and intercom system with a 30-to-15,000 cycle frequency response, and

(12) An air-handling system, complete with supply, return and exhaust fans, filters, temperature controls, refrigeration and heating equipment, sound-and-temperature insulated ductwork, and gravity-closing link-fuse fire dampers.

In conclusion it may be stated that this museum is not great in terms of physical dimensions; covering less than half an acre in actual ground plan. Yet, due to its high standards of design, attention to detail, scope or electrical features and quality of workmanship, this building deservedly merits the reference of having an "outstanding electrical installation."

PROPER DESIGN OF

Cut-backs in Conduit Risers

WILL REDUCE TOMORROW'S BOTTLENECKS

The high cost of replacing existing conduit riser systems installed in accordance with minimum Code requirements is one of the major problems of electrical modernization. Planned direction and active cooperation of design and contracting interests are needed to keep the same mistakes out of new construction.

ONE of the big stumbling blocks in the present modernization program is the long-accepted practice of reducing conduit riser sizes at succeedingly higher floor levels of multi-floor buildings in accordance with minimum provisions of the National Electrical Code. Very rarely can old buildings be modernized today within existing raceways for even the present capacity demand. Moreover, in a majority of *all* cut-back installations, old *or* new, it is impossible to pull in new feeders which will produce a worthwhile capacity increase for the cost involved.

Plans for rewiring are being abandoned in the face of the high cost of replacing conduit risers which had been cut back to size without provisions for future expansion; whereas, had cut-backs been made 2 or 3 floors higher, capacities could have been doubled or trebled simply by pulling in new conductors.

Example

To explore the capacity increases possible using a typical cut-back riser, assume that a 6-floor apartment building was wired according to minimum Code requirements, as shown in Fig. 1, each riser accommodating six 600-sq-ft apartments. Single-phase 120-volt service was furnished each apartment, and the conduit riser was cut back in size at every available opportunity. Feeder load was computed on the basis of 3 watts per sq ft for general lighting plus one 20-amp small appliance circuit, resulting in the use of No. 8R feeder conductors.

Assume the owner finds it necessary, in order to maintain rentals, to furnish additional capacity for the use of modern appliances, desiring to take advantage of the Code provision permitting existing raceway to be filled to 50% capacity for rewiring work. Using smaller-diameter TW conductors, what increase in capacity can be expected?

Table I shows the number of Type T or TW conductors permitted by the Code for each of the conduit sizes making up the riser of the above example. The third column of the table indicates the number of conductors required between each floor for a 120-volt, 2-wire circuit to each apartment from a 120/208-volt, 3-phase, 4-wire service. Circled numbers show the largest size conductor which will satisfy the conditions. Thus, existing riser sections between three of the floors will handle No. 4 conductors, but three of the sections will handle only No. 6's. This

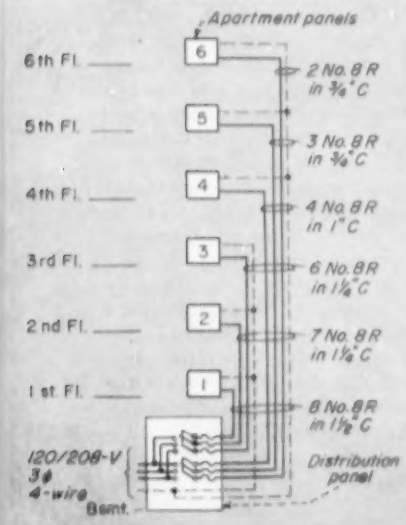


Fig. 1 ORIGINAL FEEDERS

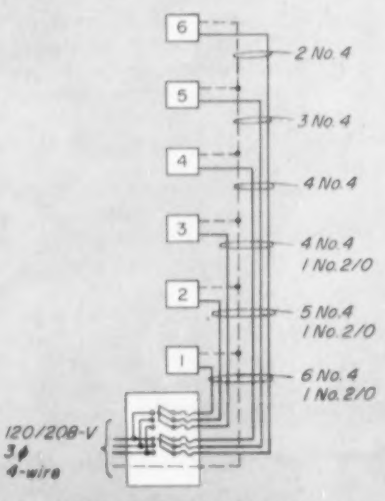


FIG. 2 COMMON NEUTRAL

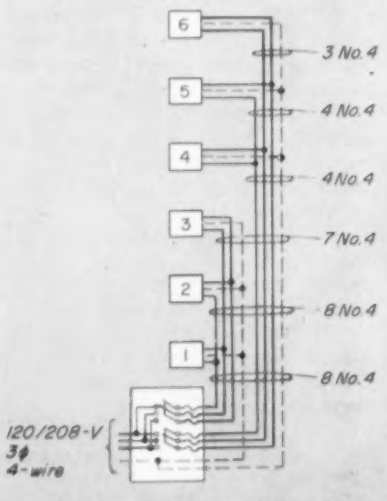


FIG. 3 208 VOLTS TO APARTMENTS

Table I. Number of Conductors Permitted for Rewiring of Existing Raceway*

Floor	Existing Riser Size (inches)	Number of Conductors Required	No. of Conductors Permitted (T or TW)**			
			#8	#6	#4	#2
5 to 6	¾	2	6	3	(2)	1
4 to 5	¾	3	6	(3)	2	1
3 to 4	1	4	9	(5)	3	2
2 to 3	1¼	6	9	9	(6)	5
1 to 2	1¼	7	9	(9)	6	5
B to 1	1½	8	9	9	(9)	6

* See Fig. 1

** Circled numbers indicate maximum size conductor which will fill the requirements specified in the third column.

Table II. Minimum Conduit Sizes Required for Additional Capacity

A	B	C	D	E	F	G
Floor	Existing Riser Size (inches) #8 wire[1]	Conduit Size Required (inches)				
		Fig. 1 #4 wire[1]	Fig. 2 #4 wire[2]	Fig. 3 #4 wire[1]	Fig. 4 #2 wire[1]	Fig. 5 #4 wire[1]
5 to 6	¾	¾	¾	1	1¼	1
4 to 5	¾	1	1	1¼	1¼	1
3 to 4	1	1¼	1¼	1¼	1¼	1¼
2 to 3	1¼	1¼	1¼	1½	1½	1¼
1 to 2	1¼	1½	1½	1½	1½	1½
B to 1	1½	1½	1½	1½	1½	1½

[1] Full neutral

[2] #2/0 neutral first three floors; #4 neutral last three floors

restricts the possible capacity increase to the use of No. 6's, with a carrying capacity of 44 amps as compared with the 32 amps provided by the No. 8's. Pulling out the No. 8's and replacing them with No. 6's would increase the power available to each apartment by 1440 watts at 120 volts, only enough for the additional operation of a good-sized electric broiler or waffler.

Table II, Column C, shows the conduit sizes required to permit the use of No. 4 conductors, the next larger size, which would increase the available current to 56 amps per apartment.

In a further attempt to squeeze more capacity out of the original riser, the question arises as to whether the feeder could be increased to No. 4 conductors if a common neutral were employed for the two 4-wire feeders in place of the two existing neutrals, as shown in Fig. 2. This system (permitted by Art. 2204 of the Code) decreases the number of conductors required in the riser, but it increases the size of the neutral through part of the run. Table II, Column D, gives the conduit sizes required for No. 4 phase conductors, showing that the same riser bottlenecks exist with this arrangement as with the other.

Air Conditioning

It is obvious that a building owner will not be satisfied with spending thousands of dollars to pull new wire into existing conduit if the net result is an increase in capacity of 1440 watts per apartment. This still does not satisfy even the most modest air conditioning requirements, one of today's chief motivating factors for rewiring. Air conditioning equipment, along with many other appliances, makes it necessary that 208 or 220 volts be made available to each apartment. Modifications of the original feeders of Fig. 1 for 120/208 volts to apartments is shown in Fig. 3.

Assume that new wiring is to supply (1) a general lighting load of 4 watts per sq ft; (2) two 20-amp small appliance circuits; and (3) a 1-ton, 208-volt air conditioner rated at 1680 watts. This is a reasonably adequate design for rewiring an apartment of this size, discounting the use of built-in electric cooking, heating, or water-heating equipment.

Calculations show that No. 4 conductors with a full neutral will handled this load. Table II, Column E, gives the required conduit sizes. Note that the original 1½-in. conduit section is the only section which is still adequate.

It is not probable that a 3-wire, 110/220-volt service would be available for the new system, since original service to the building was 3-phase. However, for the sake of completeness, the load described above would require No. 2 conductors using the feeders shown in Fig. 4, with the resultant increase in riser requirements shown by Table II, Column F. These requirements would be somewhat reduced using the three-feeder system of Fig. 5 and Table II, Column G; but the increased conduit fill, though permissible, may make the wire difficult—if not impossible—to handle.

(Continued on Page 192)

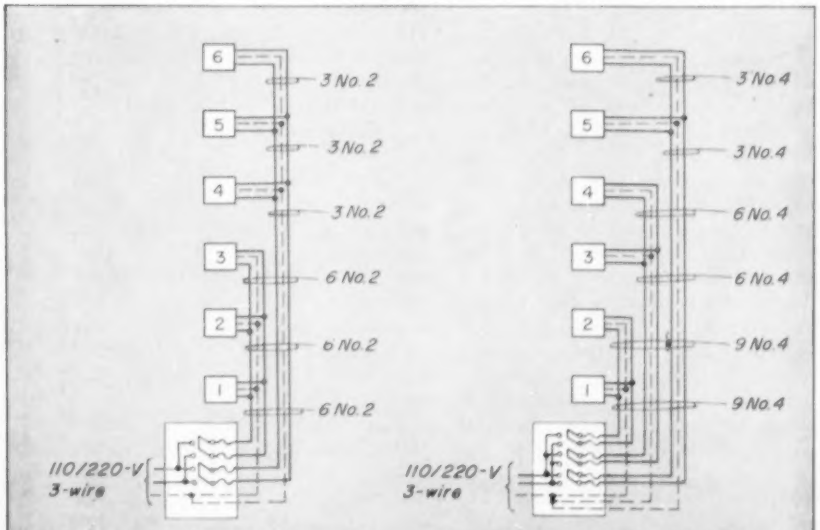


FIG. 4 TWO 3-WIRE FEEDERS

FIG. 5 THREE 3-WIRE FEEDERS

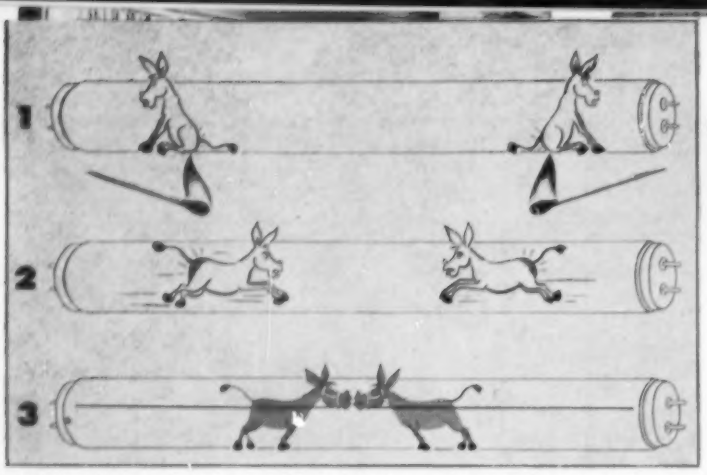


FIG. 1—Ballasts function to: (1) preheat lamp electrodes; (2) start the lamp with a controlled high voltage and current surge; and (3) limit and control voltage and current at lower lamp operating levels.

The "WHYS"

By Max D. Orr
Vice President
Advance Transformer Company
Chicago, Ill.

WE all know that a ballast is an integral part of a fluorescent fixture and that without it the lamps will not burn. Why is this so? Why must ballasts be of the physical size and shape we find them? Why do ballasts overheat, become inoperative, or hum? These are reasonable questions which at some time or another may be asked of the lighting engineer, electrical contractor or electrical maintenance engineer. The following discussion is designed to answer these questions and provide a solution or two to problems which might arise.

Operation of fluorescent lamps, unlike incandescent lamps, is highly complex. The incandescent lamp functions by a flow of current through a wire filament which becomes white hot and produces light. This hot wire or filament also serves to limit the current to safe operating values. Incandescent lamps operate directly from the available power line and can be controlled by a simple "on-off" switch.

The fluorescent lamp with its higher lighting efficiency, longer life, variety of shapes and sizes and range of color choices, is an electric discharge device which cannot be connected directly to the line. Unless the flow of current is stabilized in some manner, more and more current will rush through until the lamp becomes inoperative. The present day variety of fluorescent lamps requires various starting voltages and currents, depending on the length, diameter, construction and gases with which they are filled. Hence, a device is needed to:

1. Provide a controlled amount of electrical energy to preheat the electrodes of the lamp.

2. Supply a controlled surge of high voltage and current to start an arc between the lamp electrodes.

3. Control and limit (after lamp ignition) the electrical energy to the lower voltage and current at which the lamp continues to operate.

To receive peak performance from fluorescent lighting it is most essential that the ballast—the heart of a fluorescent fixture—match precisely the electrical requirements of the lamps it has been designed to operate. A ballast, built to exacting standards, performs the three functions (Fig. 1) necessary to operate a fluorescent lamp.

Ballast Size

Manufacturing methods and materials readily available today dictate a cube shape for the most economical ballast design. However, a ballast so constructed would not lend itself to the pleasing design of the smart long lines of a fluorescent luminaire.

When fluorescent lighting was introduced, it was used primarily for decorative purposes and the physical dimensions of a fixture were not too important. With the introduction of larger lamps and the two-lamp ballasts, lamp were combined to operate in groups to attain higher lighting intensities. With this development, a cube-shape ballast used with suspended fluorescent luminaires took on the appearance of a camel with the ever-prevalent and predominating hump. To overcome this objection, ballasts were made rectangular in shape so they could be concealed within the wiring channel of the fluorescent fixture. Today, ceiling heights in schools, offices, stores and industrial interiors are being lowered to save on construction costs. Where it was once common to have ceiling heights of 15 to 25 ft, we now have ceilings as low as 8 ft. Consequently, in the majority of new construction, fluorescent luminaires can no longer be suspended from stems. They must, of necessity, be recessed or mounted directly on the ceiling. Low ceilings create new problems for the lighting industry and new demands on the ingenuity of lighting designers and engineers. The manufacturer of lighting equipment turns to the ballast industry, as the depth of a fluorescent luminaire is controlled only by the depth of the ballast and the diameter of the lamp it has been designed to operate.

Why Not Shallow Ballasts

Since, in some instances, ballast heights have not been reduced to the diameter of the lamp they operate, you might ask, "Why is it difficult to design and manufacture shallower ballasts?" This can be summarized best by two words:

1. performance
2. heat

When speaking of ballast performance, we must consider, from the lighting industry's standpoint, economics as related to cost. Also, mechanical construction that affects adaptability of the ballast to the luminaire; the noise level of the ballast; and finally, the electrical performance of the ballast for specific lamps.

The consideration of our second factor, heat, may also be correlated

# of FLUORESCENT BALLASTS

. . . a simplified explanation of ballast function, design and operation in a fluorescent fixture.

FIG. 2—Ballast life depends on maintaining normal internal operating temperature of 105° C. For each 10° C increase above this level, ballast life will be cut in half.

to another "why" of ballasts . . . Why does a ballast become inoperative? Experience and research with ballasts have taught us that the various insulating materials used in the construction of ballasts today cannot be operated at excessive temperatures without adversely affecting ballast life. These insulations, known as Class A, include cotton, paper, silk and similar impregnated materials.

To conform to Underwriters Laboratories requirements (providing margins of safety) present-day methods of testing ballast temperatures stipulate that the normal operating internal temperature by resistance shall not exceed 105° C. If properly constructed, the maximum ballast case temperature will not, therefore, exceed 90° C.

An analysis of the Class A insulating materials shows this: if the internal ballast temperature exceed 105° C on continuous operation, *the life of a ballast will be cut in half for each increase of 10° C* (Fig 2).

Why Ballasts Overheat

There are many factors affecting ballast temperatures. A fluorescent lamp ballast, like other electrical equipment, generates heat during normal operation. Heat generated in the conventional ballast is transferred to the case through a silica compound which totally surrounds the internal components. The heat is then dissipated to the surrounding air or mounting surface by conduction, convection or radiation. Hence, the ballast must be placed in an enclosure suitably ventilated to provide for a maximum ambient temperature of 40° C. Where more than one ballast is installed in an enclosure, the units should be positioned far enough apart to provide for the combined normal heating effects.

To prevent abnormal ballast operating temperatures, fluorescent luminaires should be designed to provide:

1. Ballast mounting with the maximum number of sides in direct contact with the metal channel of the fixture.
2. Fixture housing ventilation by means of louvers or holes.
3. Increased heat radiation by painting the inside of the fixture channel with a dark nonmetallic finish.

In some cases it is advisable to place the ballast in a cooler location outside the fixture.

Where large numbers of ballasts are used on a single circuit and other means of cooling a fixture or ballast are not available, *individual ballast fusing is recommended.*

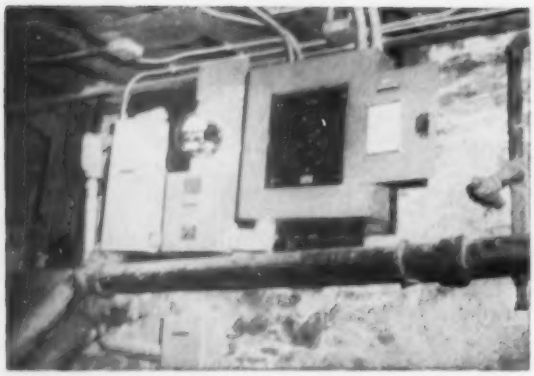
Most important perhaps, is the precaution of mounting the fixture so as to attain maximum dissipation of heat by conduction, convection or radiation.

A fluorescent lamp fails, not by burnout, but by deactivation of the cathodes. When this happens, the arc is extinguished. Referring to Fig. 1, you will recall the 1st and 2nd functions of the ballast are brought into service . . . cathode preheat and high starting current is required almost constantly. This excessive current flow through the ballast generates heat, resulting in abnormal ballast temperature. *Operation of fluorescent luminaires with deactivated lamps is detrimental to the life of the ballast and should not, under any circumstances, be permitted for a longer period than 3 or 4 hours.*

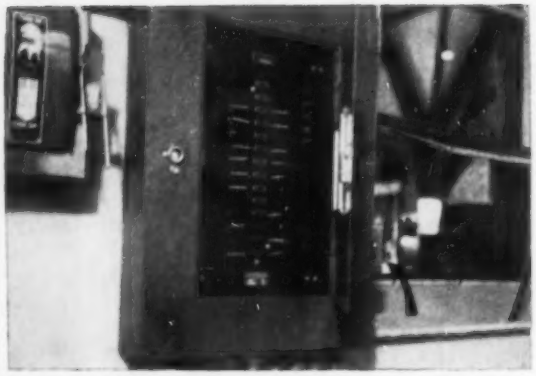
Why Ballasts Hum

While ballasts of good design have a hum barely discernible to the ear, we have become so accustomed to the quiet operation of the incandescent lamp that we will not tolerate even the slightest ballast noise. Ballast hum originates from the magnetic action in the core and coil assembly. This can be amplified by any loose section of the ballast. *Possible loose components capable of producing noise, may be core laminations, joints in the core structure, capacitors, and ballast cases.*

The total audible noise produced by any lighting installation depends upon the ballasts. Mounting of ballasts in the fixture; ambient noise levels; resonant qualities of the ceilings, walls and furniture should be considered in the early stages of fixture design and installation planning.



COMPACT SERVICE LAYOUT was necessitated by presence of heavy soil pipe running across wall at point of service entrance. Underground conduit from splice box to pull box at the property line was oversized to permit economical increase of service capacity. New equipment is rated at 100 amps, 3-phase, 4 wires.



LIGHTING CONTROLS for the main areas of the church are situated in the consistory room at the side of the nave. Looking through window at right, the sexton may follow services and change the lighting patterns accordingly. Pushbutton (arrow) is of m-c type to actuate dimmer. Switch protects dimmer from operation by unauthorized personnel.

MODERNIZED CHURCH FEATURES . . .

Low-Cost Programmed Lighting

New electrical equipment in St. John's Church, Brooklyn, N. Y., includes lighting system that delivers adequate general illumination, enhances English Gothic architectural style of the structure, plus flexible controls that permit programmed lighting of services.

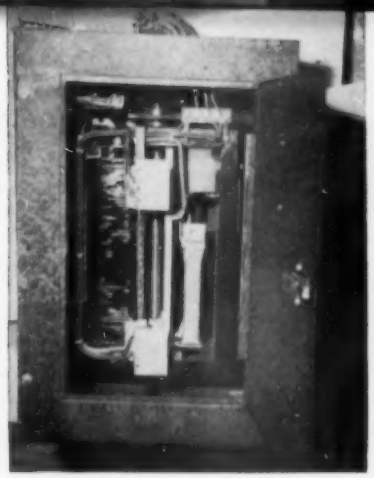
PROGRAMMED lighting is an integral and dramatic element of religious worship in the recently modernized St. John's Episcopal Church in Brooklyn, N. Y. The low-cost components that make this unusual application possible are part of a carefully planned new electrical system designed to provide the highest levels of convenience and service within the means of this small church.

As it stands today, the church takes the traditional form of a cross, with the nave (seating area) and the chancel (sanctuary and choir areas) forming the long arm and the transepts composing the cross arm. In addition, there is a 14-ft wide consistory room running along one side of the nave and a sacristy at the side of the chancel. Full basements beneath the transept, chancel and sacristy are utilized as sunday school, kitchen and choir rooms, while the 6-ft deep basement under the nave is used for a boiler room and storage area. Antiquated wiring and lighting equipment in all areas required 100% replacement to assure safety and adequacy.

In designing the new system, architect Samuel L. Snodgrass, who represented the rector and the vestry, and A. L. Arthur, consulting engineer, gave primary attention to obtaining a lighting arrangement that would highlight the significant architectural features of the structure and at the same time lend added dramatic impact to religious services.

A principal element of the new installation consists of 12 cylindrical, gothic-style lanterns providing both direct and semi-indirect general lighting in the nave and transept. The ten units hung in two rows in the nave accommodate a 500-watt downlight in a reflector assembly plus six 50-watt IF lamps mounted along the axial stem of the 3-ft 2½-in. lantern. Hanging height of lanterns was calculated to have downlight beams intersect 9 ft above the center aisle in order that the top of the processional cross be well lighted as it is carried to the chancel. The two units in the wings of the transept are identical except in the height dimension which is six inches greater to conform with the proportions of the transept. In actual practice, 300-watt IF lamps are used in the downlights to achieve better balance with the lighting of the alter and choir sections.

Hanging the lanterns and installation of new wiring for them presented several problems. The col-



MOTOR DRIVEN DIMMER rated at 4000 watts is mounted on boiler room wall directly beneath consistory room panel. Unit is connected ahead of the B-phase bus of the panel and regulates all downlights in nave and transept lanterns.

LIGHTING CIRCUIT CONDUITS for ceiling lanterns of church were run along basement ceiling to beams below arches. Precision workmanship was required to run conduits up around beams and offset into channel on the face of arches.

CURVED COURSE OF CONDUITS to nave lanterns is shown looking up along arch to lantern at right. EMT wooden conduit is in hollowed-out space under wooden molding (arrow). Original wiring had no raceway in the molding.

lar beams from which the lanterns were to be suspended could not support the heavy wrought-iron-framed luminaires. To overcome this, Hendrickson-Heffernan Co., custom lighting specialists who made the lanterns, produced special hangers with U-shaped straps of ornamental wrought iron at either end that were bolted into the collar beam and the heavy arched strut above at the point of fixture suspension.

Wiring for the original lighting equipment had been distributed as knob-and-tube work along the ceiling of the shallow basement beneath the nave, then continued from the nave floor up along the arched strut in a hollow space in the wooden face molding on the strut. Since modern electrical standards required raceway protection for the vertical runs as well as the basement portions, the installer was faced with the problem of concealing the conduit risers up to the collar beam. Contractor A. S. Reynolds, also of Brooklyn, N. Y., obtained a satisfactory solution by cutting a channel into the face of the arched strut that was small enough to be hidden by the wooden molding but large enough to accommodate ½-in. EMT conduit. The small outside dimensions of crimp-on couplings fitted neatly into the narrow channel. Lengths of tubing were made up, then warped into the recess in the arched strut by hand pressure and secured. All equipment for each location—conduit, wiring, hangers and luminaires—was installed at a single time to minimize relocation of scaffolding.

NAVE LANTERNS provide direct downlighting for reading of hymnals and soft general illumination from six-lamp cluster on a separate circuit. Downlights are dimmed during sermons and readings from the lectern. Although larger lamps may be accommodated, 50-watt IF lamps are used in the general lighting assembly and 300-watt IF lamps were found most suitable for the Alzak reflector downlights.

PULPIT IS SPOTLIGHTED during sermons by an economical spun aluminum unit concealed above on the reverse side of the Crossing arch. Hymn-board light and custom-built pulpit fixture that illuminates both the reading desk and the antependium cloth at the front combine to achieve an impressive effect. The lectern at the opposite side of the chancel is similarly lighted.

ARCHED NICHES around the sanctuary are emphasized by recessed high-hats near the peak of the arch and by continuous cove of 25-watt incandescents in the top of the wood paneling below. Combination up- and down-light in the reredos highlight the altar cross and the mural at the rear. Gilded vaulting is lighted by 16—300w reflector lamp units.

LOW-CEILINGED STAGE at end of sunday school room becomes a more useful area by removal of antiquated footlights and installation of steps across the entire frontal. In addition to recessed 150-watt units shown here, the platform is also served by two 150-watt spots in spun aluminum holders wall mounted 15 ft in front on the platform.

CUSTOM-BUILT BRACKETS of wrought iron are each lamped with two red-orange bulbs. Sconces complement the color and form of the large window and wall ornamentation and provide ample illumination for passage through the narthex. Subsequent phases of the modernization program will include refinishing of walls and ceiling to further brighten the church interior.

SUNDAY SCHOOL ROOM was converted to a bright, attractive area by replacing old glass-globed incandescents with two-lamp direct-indirect fluorescent luminaires. Units have plastic side panels and baked enamel louvers. Because of the irregular arrangement of beams, fixtures were either mounted on the bottom of beams or suspended to the same level to obtain uniform appearance.

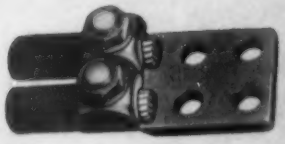
Lighting for the sanctuary and the adjacent choir section had two functions to perform: general illumination of the area and highlighting of the gilded vaulting and arched window niches. Twin assemblies of eight 300-watt reflector lamp units with adjustable bases are the principal components in the low cost installation designed to meet these requirements. The assemblies are made up of surface metal molding and outlets spaced on 15-in. centers along the inner side of the chancel arch to conceal them from the congregation. The lowest unit is mounted 14 ft. above the floor of the choir area to avoid glare. The four lower units on either side are directed downward to provide general illumination while the upper four are employed as floods for the vaulting. Both flood and spot lamps are used according to the distribution requirements of the individual units. Special effect and general lighting units are on separate circuits to afford flexibility of lighting arrangement.

Other equipment in the area includes a cove of 25-watt incandescents along the base of the six side window niches recessed into the ornamental wainscot; also standard high-hat units near the point of the arched niches. These latter units were installed only on the side of the niches nearest the nave so the light source would not be seen by the congregation. A combination up- and down-light in the wooden reredos surmounting the altar affords illumination for the mural above and for the altar cross. Individual 150-watt spots mounted in the rafters above the pulpit and the lectern complete the lighting layout in the chancel.

The lighting panel controlling all circuits on the main floor is strategically located in the consistory room alongside a swinging stained glass window opening on the nave. From this point the sexton has an unobstructed view of the chancel area and can adjust the lighting arrangement as the services progress. In addition to the circuit breaker switches in the panel, light control equipment includes a 4000-watt Autrastat motor-driven dimmer regulating the intensity of the downlights in the nave and transept lanterns. This unit is mounted

(Continued on Page 193)

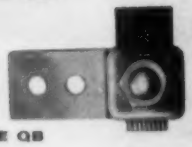
how's your QA-IQ?



TYPE Q2A

TYPE QA-90

TYPE QQA



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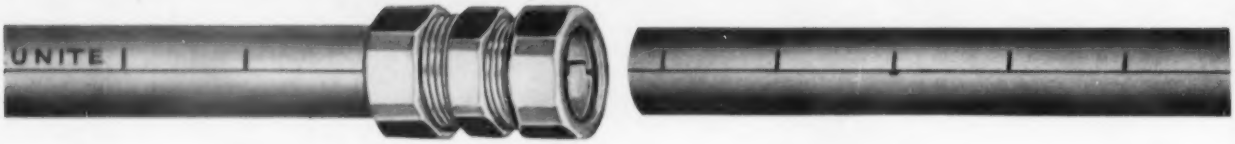

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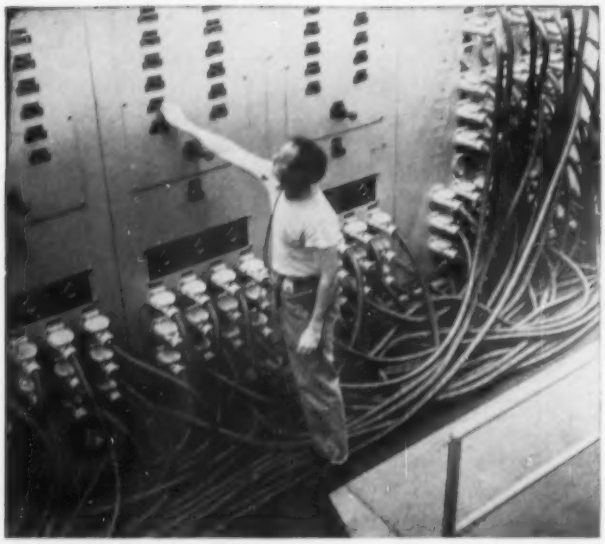

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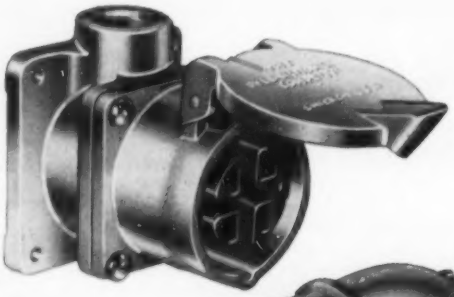

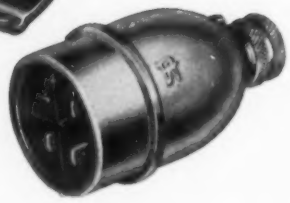

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Practical Methods

Motorized Cable Re-Reeler for Shop Use

CONSTRUCTION

Customer service is one of the foundation stones of W. R. Grasle Co., successful electrical construction firm in Portland, Oregon. Whether it be the solution to an engineering problem, starting a construction project on time, or simply getting a piece of cable over to a customer's premises in a hurry, W. R. Grasle, Sr., is a firm believer that the customer's interests come first.

For that reason, the firm maintains a substantial inventory of wire ranging from branch circuit conductors to heavy feeder cables. Inside the shop, one reel-rack alone accommodates more than three dozen reels of cable in the No. 4 to 500 MCM range. Cable reels are suspended by heavy steel pipe and rod axles supported by V-flange plates mounted back-to-back on continuous channel (Unistrut) uprights extending from floor to ceiling.

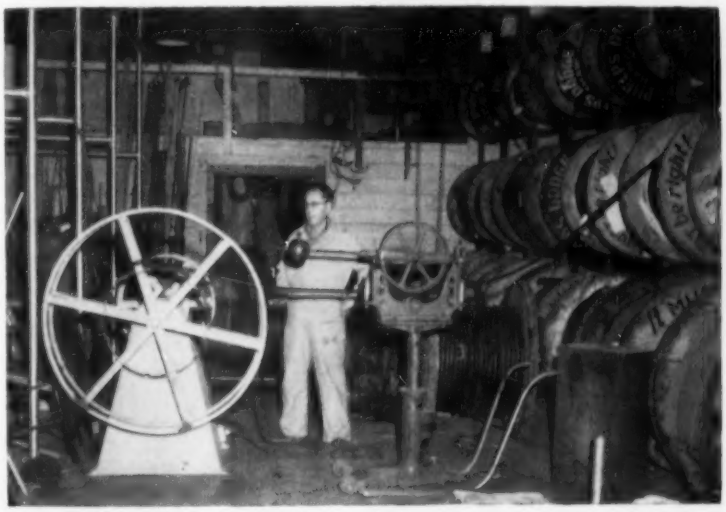
Frequently, specific cable requirements on jobs in progress, and especially emergency projects, are met from the cable in stock. This eliminates possible delays in ordering and delivery. Often this practice involves un-reeling and measuring definite lengths of cable from the stock reel and coiling it up for immediate delivery. To do this by hand would take considerable time and be especially cumbersome with large size cables.

To speed up this shop operation, Grasle developed a motorized cable re-reeler and added a portable cable measuring device. Now, one man can re-reel up to 500 ft of any size cable up to 500 MCM size in a matter of minutes.

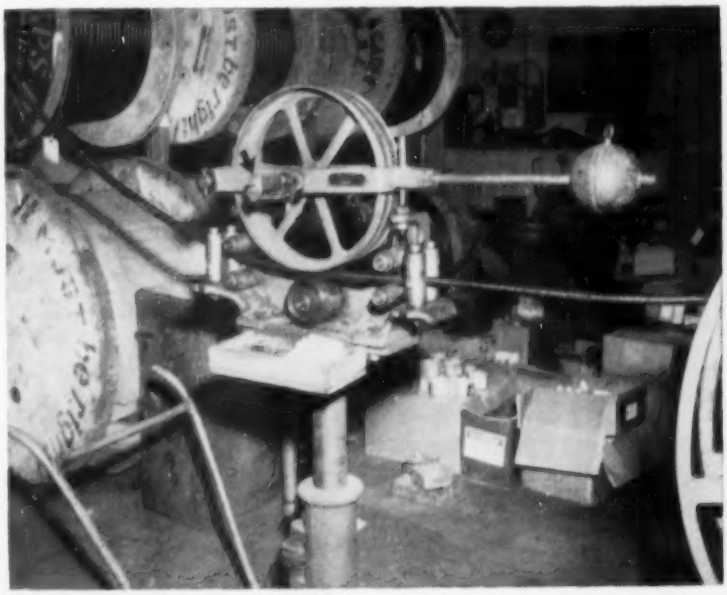
The re-reeling unit consists of a motor-driven shaft with a steel drumwheel on each end. The large wheel, for heavy cable, is 48 in. in diameter; has a 22-in. diameter center drum 6 in. wide. The small wheel is 25 in. in diameter with an 11-in. drum also 6 in. wide. The outer spider on each wheel is held in place by tangential slots in extended drum fingers. It can be removed quickly to take off the coiled cable wound on the drum.

A pyramid-shaped base, constructed of heavy steel plate, supports the wheel drum shaft and encloses the driving mechanism. Basic power source is a 3-hp, 110-volt, single-phase motor which drives a gear box through an adjustable speed V-belt connection. A chain-drive connects the gear box to the wheel-drum shaft. Change in rewind speed is provided by merely turning a wheel which varies the pitch diameter of the V-belt pulley on the motor shaft. A plug-in, heavy-duty extension cord with a single "start" button permits the operator to control the re-reeler while watching the counter on the cable measuring device.

As the cable comes off the reel,



MEASURING AND RE-REELING cable for job requirements has been reduced to a one-man chore by addition of a motorized re-reeler at W. R. Grasle Co., Portland, Oregon. Note stock of heavy cable stacked (at right) for easy pay-out.



CABLE PASSES through measuring device on way from reel to rewind drum. Counter (arrow) geared to weighted idler wheel indicates footage rewound. Adjustable pedestal for device is mounted to portable base.

MOTORIZED RE-REELER has two wheel-drums on common shaft supported by heavy steel pedestal base. Outer spider on each drum is removable. Drum on left can take up to 500 ft of 500 MCM cable. Unit is controlled by single pushbutton on plug-in extension cord.

CHAIN DRIVE turns re-reeler shaft through gearbox which is V-belt driven by 3-hp motor. Rewind speed can be changed by turning wheel in front which varies pitch diameter of V-belt pulley on motor. Guard over drive has been removed.

it passes through a cable measuring unit consisting of series of cable supporting rollers and large-diameter idler wheel which rides the top of the cable. Pairs of horizontal and vertical guide rollers are adjustable to cables of various diameters and keep the cable from whipping and snaking as it is being re-reeled. A conventional counter, geared to the idler wheel, indicates the number of feet of cable being payed out. An adjustable weight, on an extension arm attached to the pivoted idler-wheel harness, provides tension and constant pressure on the cable as it passes through the measuring unit. The entire assembly is mounted on an adjustable and portable pedestal that can be easily moved in front of any reel on the shop rack.

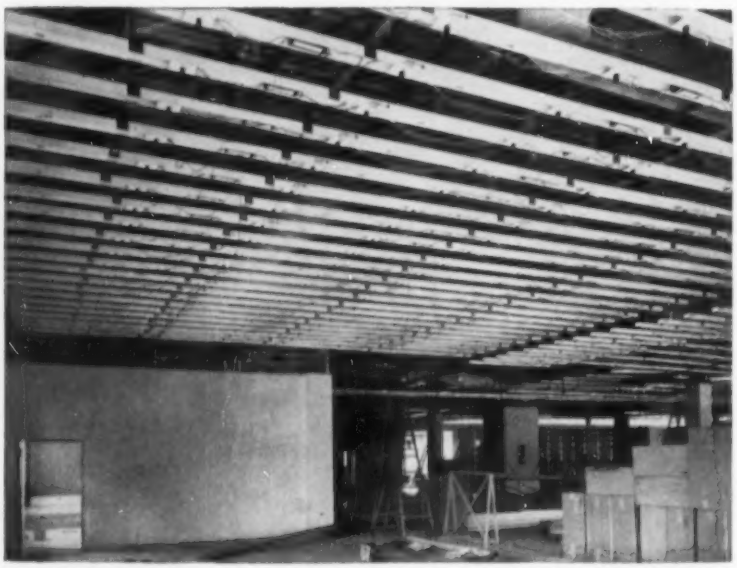
Shop men at the Grasle firm are as enthusiastic as management about the re-reel system. When a call comes in for immediate delivery of a specific length of cable, one man can now handle the requisition without waiting for help or disrupting the activities of other shop men. And it even helped the firm get an adjustment or two from manufacturers when it was discovered, after the re-reeling process, that an original reel of cable accidentally contained less footage than indicated. Biggest advantages of this new equipment addition, from Grasle's viewpoint, are increased shop efficiency, convenience in handling, and better customer service.

Luminous Ceiling Provides Even 80-FC

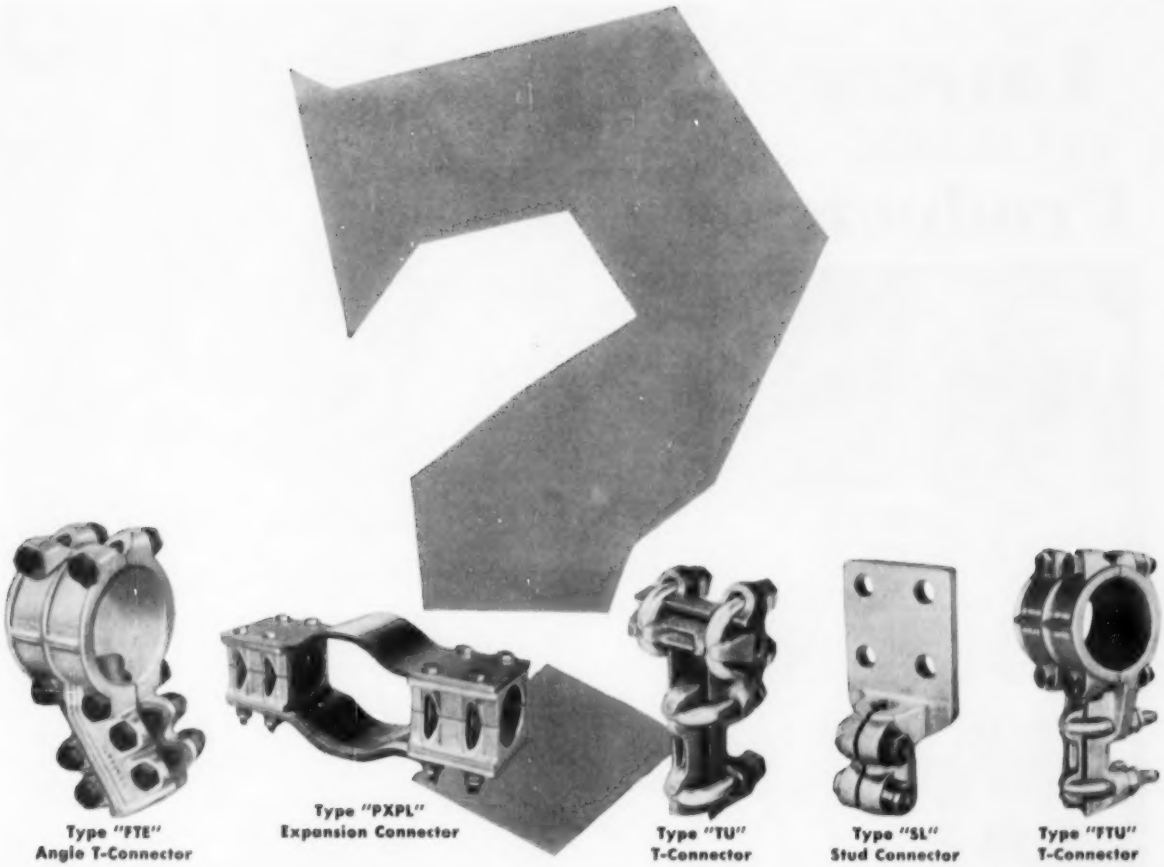
LIGHTING

The Davis and Geck division of American Cyanamid, located in Danbury, Conn., is illuminated predominantly by Acusti-Luminus Ceilings. These corrugated luminous panels are backlighted by 40-watt T-12 cool-white rapid start fluorescent lamps, mounted in continuous rows located 18 inches

WINDOWLESS IBM room has 45-fc light level, 15 months after installation, with continuous rows of cool white fluorescent lamps above luminous panels.



WIRING CHANNELS are aligned by means of clamping plates that bridge and unify adjacent sections. Lamps used in this installation are rapid-start T-12s.



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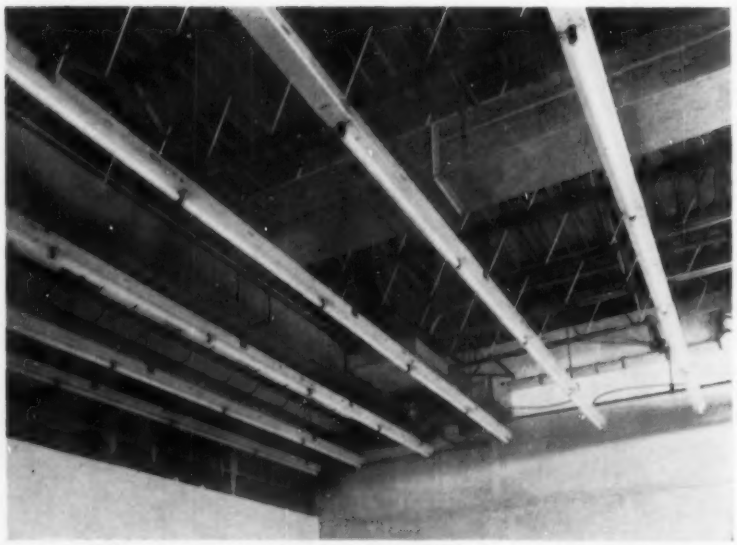

SUSPENSION of wiring channels is by means of rod hangers secured directly to roof purlins. Lighting load exceeds 8 watts per sq ft.

above the suspended plastic sheets. With lamp rows spaced on 3-ft centers, illumination on working planes averages 45 footcandles although, when spacing is reduced to 18 in. row-to-row, intensities jump to an even 80-fc.

This plant, devoted to the production of surgical sutures, has many operations where critical see-ability is essential, and lighting for these tasks is even, shadowless and glare-free beneath the ceiling installation selected.

As indicated in the construction view, wiring channels are installed beneath and at right angles to roof joists, being suspended and held in alignment by bridging clamps and rod hangers secured directly to purlins.

Surge Bonding For Farm Services

WIRING

An effective method of discharging stray electrical energy on farm electrical services is provided in a recent Bulletin No. 123 by C. P. Wagner, farm electric consultant of the North Central Electrical League, Minneapolis, Minn. The text points out that an electric line often has many stray or surge currents that are not put there by the generators. These may have a frequency many times that of the usable 60-cycle energy and must be drained away as quickly as possible. The only place to "send" them is to earth.

When currents are sent through a conduit in one direction only, the conduit acts as a choke or induction coil. Such a choking effect must be eliminated from the circuit as much as possible. Since the neutral, or grounded, conductor brings the earth closer to the lines (conductors), it protects the lines and reduces the amount of stray energy which may be present.

One method of reducing the impedance to ground is to attach the neutral conductor to the service conduit at both top and bottom (Fig. 1). When surge grounding of this type is used, the high frequency currents can travel to ground on the surface of the conduit. Without this free path to ground, these currents would be choked out while forced through the conduit itself. Farm customers in the area have long been advised to place arrestors on their wiring. Such arrestors, the Bulletin contends, are of minor value unless the energy is discharged from the neutral conductor

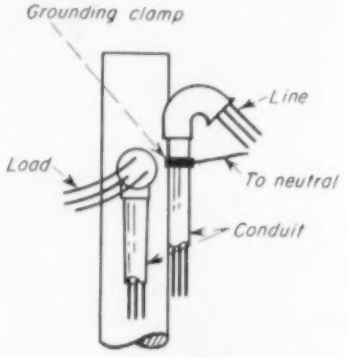

FIG. 1—Surge bond at farm service entrance consists of a tie between conduit and neutral conductor at top and bottom.

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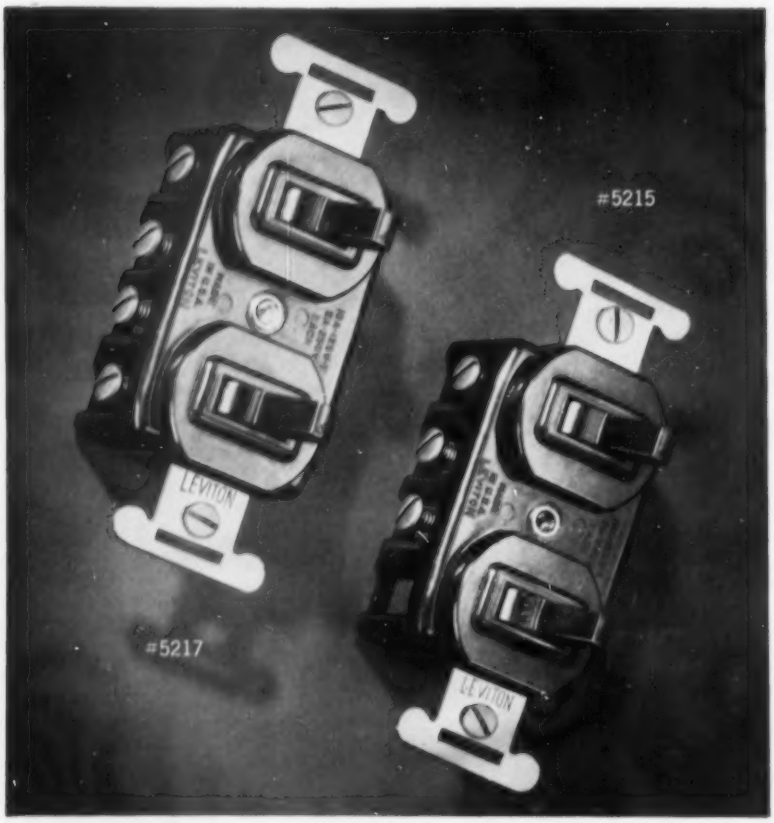

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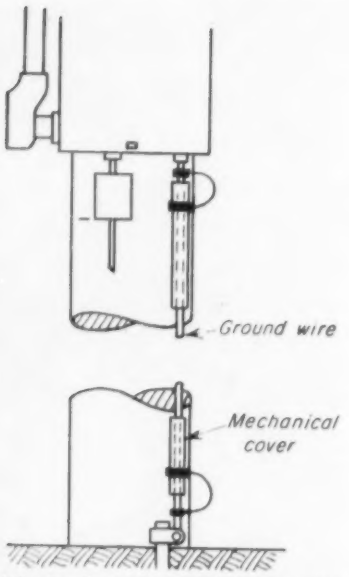

FIG. 2—Protective conduit for ground conductor should be bonded, top and bottom, to neutral or grounding conductor. Conduit surface provides free path for discharge of high frequency currents.

with minimum interference.

Surge bonds are recommended at the service head of each 240-volt service as well as at the pole service entrance.

The same reasoning applies to bonding conduits used for mechanical protection of ground wires. The conduit should be bonded, top and bottom, to the neutral or ground wire (Fig. 2). Mr. Wagner believes that surge bonding should be a vital part of a farm wiring reinspection and rewiring program.

Water-Cooled Bit Cuts Concrete-Drilling Time

CONSTRUCTION

Paralleling the increase in modernization of existing commercial and industrial building is the problem of "breaking through" concrete floor slabs to install riser conduits. Complicating the problem is the fact that much of this work must be done during regular working hours. Also, risers frequently are located in confined closets or narrow passageways. In many cases, building management forbids contractor use of electric or pneumatic hammers or any method that is noisy or will disturb employees, customers or tenants.

To overcome these objections, many contractors have resorted to concrete drilling techniques. Manufacturers have kept pace with this trend by developing equipment that

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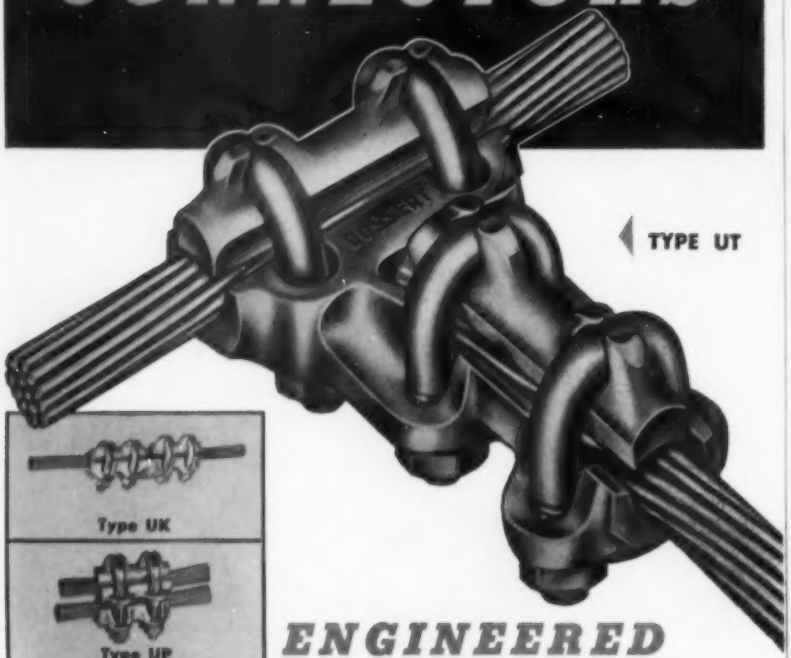

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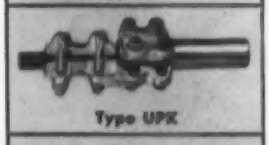
Type UP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will do the job quicker and with a minimum of noise. The net result is that holes now can be cut through concrete in a small fraction of the time formerly required.

Actual field experience bears this out. On one specific job, a saving of some 95% in time and labor costs was reported. By using a Truco Water Swivel attachment for an electric drill and a Truco Swivel diamond bit, the Huffman-Wolfe Co., Dayton, Ohio, cut more than 20 6¾-in. diameter holes in the 7½-in. reinforced concrete floors at the Rike-Kumler department store in Dayton.

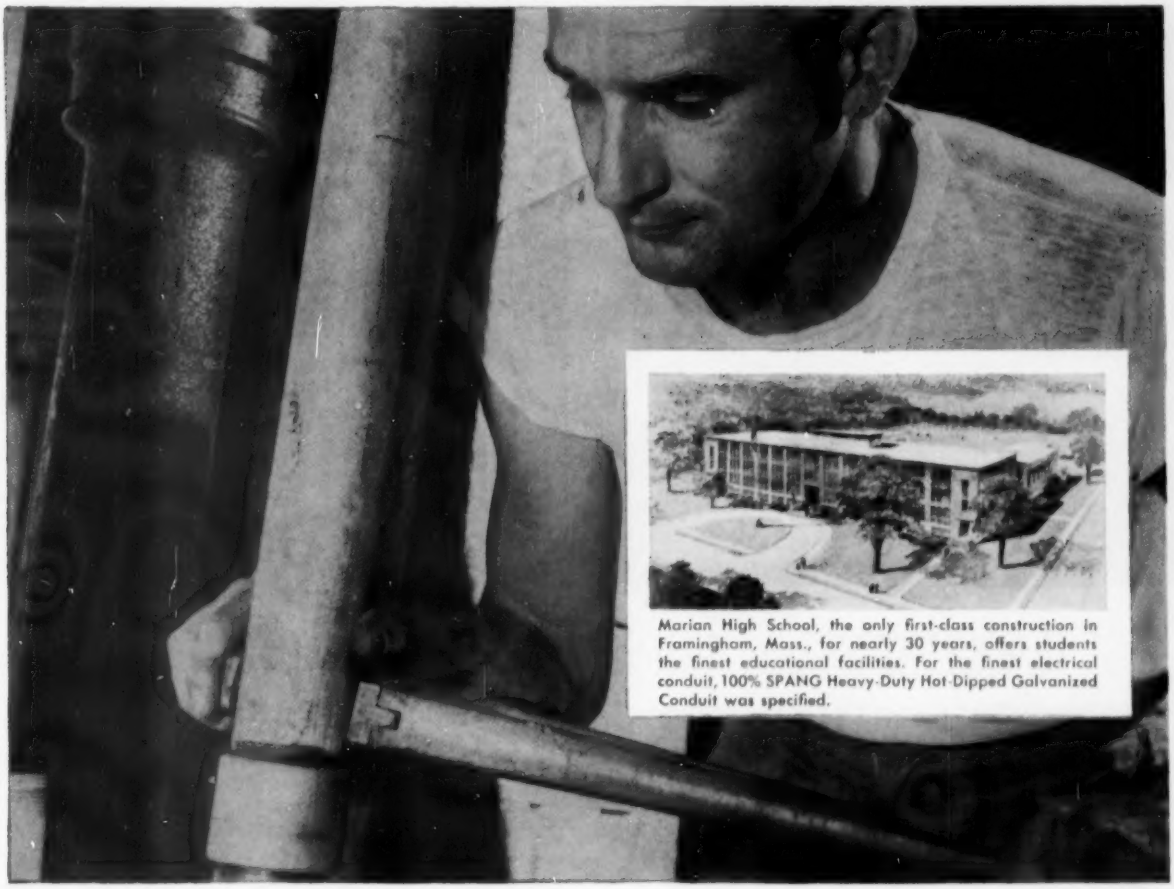
Average time per hole was only 12 minutes. This compares to an estimated four hours (240 minutes) per hole by conventional "break-through" methods. Since all holes were made in narrow corridors, drilling was restricted to a one-man operation. Subsequent patching was held to a minimum. Net result was a saving of at least a week in the time required to finish the job.

The diamond bit used on this job was 6¾-in. diameter and 18 in. long. It was mounted on a heavy-duty water swivel attachment which, in turn, was mounted in a ¾", heavy-duty, 350 rpm, electric drill. The swivel attachment supplied coolant water to the cutting edge of the bit. Although a 1-in. drill is normally recommended for a bit of this size, the slow-speed ¾-in. drill proved adequate in this case.

"SPANG HD Conduit is the top-quality product of the field... and will outlive the life of the Building!"

says Ed Hann, electrical foreman at Marian High School, Framingham, Mass.

Owner: Archdiocese of Boston, Mass.
Architects: Whelan & Westman, Boston.
Contractor: Thomas O'Connor, Cambridge.
Electrical Contractor: M. B. Foster Electric Company, Boston.
SPANG Distributor: Westinghouse Electric Supply Co., Boston.



Marian High School, the only first-class construction in Framingham, Mass., for nearly 30 years, offers students the finest educational facilities. For the finest electrical conduit, 100% SPANG Heavy-Duty Hot-Dipped Galvanized Conduit was specified.

When asked why SPANG Heavy-Duty Hot-Dipped Galvanized Conduit is being used exclusively at Marian High School, Ed Hann said: "SPANG HD insures us of an efficient, workable installation because we get better bends, more flexibility and consistency, with no hard spots and no flaking at the bends. The labor factor is minimized by the fact that we get good, clean threads in ready-to-use condition in every shipment."

About the dependability of SPANG HD Conduit he reports: "It doesn't matter whether we are making a bend two feet from the end or five feet, the same methods and techniques are applied, and we come up with the identical bend regardless of the position. This means that we work faster, and come up with a better looking job . . . it takes a *top-quality* product to yield consistent true bends. This is the quality that we get in all sizes with SPANG Conduit."

The Marian High School report testifies to the benefits of SPANG'S careful *quality-control* . . . *top-quality* conduit that's easy to bend, cut, thread . . . that assures easy wire fishing . . . that cuts installation time and costs.

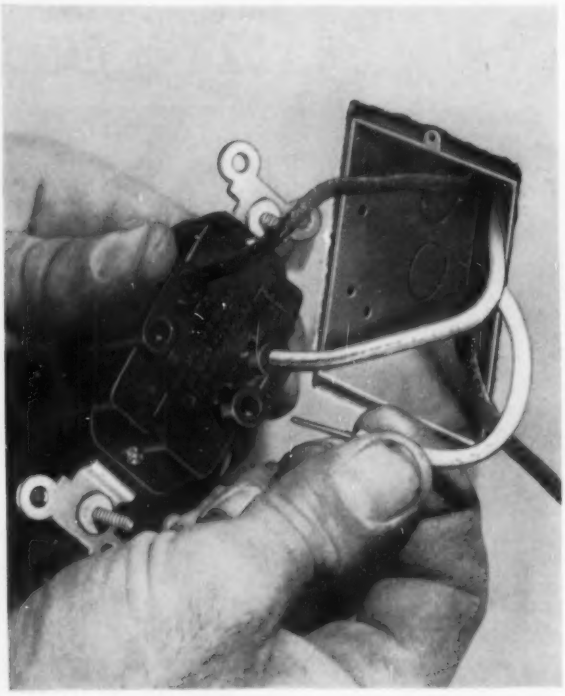
It's the *quality-control* features of SPANG Conduit that create loyal SPANG customers like Mr. John Woodruff, purchasing agent for the M. B. Foster Electric Company, who says: "No matter which of our dozen jobs you go to, you will find them 100% SPANG. It's always our first choice."

SPANG'S *quality-control* can mean more efficient conduit installations for you, too. Your nearby SPANG Distributor carries the complete line of SPANG Conduit—SPANG HD, SPANG Black, SPANGLEAM EMT.

SPANG CONDUIT

SPANG-CHALFANT
Division of The National Supply Company
GENERAL SALES OFFICE
TWO GATEWAY CENTER, PITTSBURGH, PA.
District Offices and Sales Representatives in Principal Cities

Better devices for



New SILENT Mercury Switch

with lighted handle as added feature . . .
has extra long life

Single Pole

Three-Way

Turns lights ON and OFF without making any sound at all. When light is OFF, a tiny neon lamp inside the handle goes on . . . makes this G-E Silent Mercury Switch easy to locate at night. Will give years of service under normal usage. Cost of operation varies with electrical rates but, on an average, is less than 1c a year.

As in all G-E Mercury Switches, a quiet pool of mercury makes or breaks the circuit. There is no mechanical action to wear out. Fewer parts to wear mean longer switch life. Life tests on these switches have run a million cycles without failure.

Ideal for installation at home entrances, in hallways, bedrooms, bathrooms, hospital rooms, hotel rooms, and motels . . . all locations where a soft light will help to spot the switch in the dark.

PRESSURE-LOCK Terminals

G-E offers a complete line of
wiring devices with this feature

30 Switches

15 Outlets

3 Ceiling Lampholders

In outlets, switches, and lampholders, General Electric offers the most complete line of devices with pressure-lock terminals. This is the new wiring method, developed by G.E., that eliminates binding screws, provides a 20% better contact, simplifies device installation, and makes a pressure connection for long, dependable service. Pressure-lock terminals have proved so valuable that General Electric has extended this new feature to a wide range of devices.

Pressure-lock terminals make wiring easy, whether you use No. 10, No. 12, or No. 14 Awg. wire. Just strip off the insulation, push wire into the terminal openings, and the G-E pressure-lock terminal grips the wire for a firm, dependable connection. Wires can be removed easily from terminals simply by inserting a screwdriver into release slots.

better wiring jobs . . .

Double Outlet

Single Pole Switch

Keyless Lampholder

Pull Chain Lampholder

Lampholder W/Outlet

New SURFACE WIRING Devices

with Pressure-Lock terminals cut costs

The G-E line of Surface-Mounted Devices with Pressure-Lock Terminals is designed for low-cost wiring ease. Devices are totally enclosed . . . no exposed current-carrying parts, and no parts to disassemble. Pressure-Lock terminals give firm, positive electrical and mechanical connection.

To wire, simply strip non-metallic cable to gage on back of each device. Insert screw driver in slot at desired end of device and remove plastic pryout. Insert stripped cable in opening, push cable until locked in place by pressure-lock terminals . . . pull cables to make sure of firm seating. Staple each cable within 6 inches of device, fasten device to surface with wood screws provided.

These are just a few of the new products developed by General Electric to help the electrical contractor do a better wiring job, more easily.

Ask your G-E distributor to show you some of the many new features that have been added to General Electric Wiring Devices. Here are features that consumers as well as contractors appreciate. Product improvements that build demand for the quality lines — like the new Lighted Handle on the popular Silent Mercury Switch, and Pressure-Lock terminals on complete lines of G-E devices, including the new Surface Wiring line.

You can depend on General Electric — for the newest developments in wiring devices, for quality products, and a breadth of line that includes everything needed to handle wiring jobs — commercial or industrial, residential or rural. In short, you can depend on G.E. for *more profit*—every time!

See the complete line of G-E Wiring Devices at your distributor's. It's constantly expanding, and every new product or product improvement is designed to make your wiring job easier, to increase your profit on every job, and add to your prestige as an electrical contractor.

Ask for descriptive literature — Ask your G-E electrical supply distributor for descriptive literature that fortifies you with facts to help you sell your customers. Ask him, too, for copies of the sales promotion pieces that are available to you for hand-outs to your customers. Or if you wish, write to Wiring Device Department, General Electric Company, Providence 7, Rhode Island.

Progress Is Our Most Important Product

GENERAL ELECTRIC

INSTALL WIREWAYS FASTER!

SQUARE D's NEW AND EXCLUSIVE *Lay-in Duct*

Square D's exclusive design provides hinged covers for both the duct sections and connectors. Easily removable fitting covers then provide a completely unobstructed wireway in which to lay wires.

LAY-IN DUCT is available in 2½" x 2½", 4" x 4", and 6" x 6" sizes, in standard lengths of 1, 2, and 5 feet. There is a complete line of fittings, all with the "lay-in" design feature.

• • •

Write for the complete story of **LAY-IN DUCT**—how it gives you a better wireway system, easier, faster and at less cost. Address Square D Company, 6060 Rivard Street, Detroit 11, Michigan.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

Motor Shops

DYNAMIC BALANCING UNIT at California Electric Co., in Oakland has two sets of pedestals: the heavy-duty ones at right for rotors up to 4 tons and 6 ft. diameter; the H-frames at left for smaller rotors. Sine-wave generator at left and Dynetric pickups on pedestals provide position and amount of unbalance on rotor under test.

Dynamic Balancing Unit for Field and Shop Use

Dynamic balancing of motor armatures is an important part of a motor repair operation. Unless armatures are in perfect balance while rotating at required speeds, serious damage can result. Bearings may wear out. The rotor may scrape against the field laminations. Equipment vibration may become excessive.

To insure against this, most motor service shops have some type of dynamic balancing equipment generally suited for relatively small motor work. Larger rotors are farmed out to specialty firms for balancing. Where variety and volume of motor repairs warrant the investment, other shops have more than one balancing unit or a single unit specifically designed to accommodate the range of motor sizes coming in for repair.

Such a flexible, multiple-range dynamic balancing unit has been designed and built in the motor repair shop of the California Electric Company in Oakland, Calif. It incorporates a sine-wave generator, Dynetric pickups and associated meter to determine the amount and position of rotor unbalance. Dual sets of pedestals take rotors from a 7-in. shaft length up to 4-ton weight, 6-ft diameter and 8-ft shaft length. In addition, the generator, pickups and meter can be easily dismantled and taken into the field for on-the-job balancing when necessary.

A rectangular base of heavy ship channel anchors the rotor supporting structure and provides a "track" for the heavy-duty, adjustable, A-frame pedestals on which large rotor shafts rest. When positioned at the two ends of the base frame, these pedestals form an 8-ft span. Two adjustable H-frame pedestals for smaller rotors (up to 1,000 pounds) slide along two sections of Shelby tubing (steel) supported by the base frame. Both pedestals and tubing can be removed when the full 8-ft span is needed for balancing large armatures.

A variety of V-block saddles, depending upon rotor weight and size, are used to seat the rotor shafts. All are of the trapeze type suspended from the top of the pedestal by drill-rod. This arrangement permits free movement of the saddle while the armature is rotating. For smaller armatures, conventional ball-bearing saddles and fiber V-blocks with felt-lined slots are used. Five-ply, end-grain, wood blocks with V-slots are added to the saddles when larger armatures are to be balanced. When rotors exceed 1,500 pounds in weight, their shafts ride in ½-shell babbitt bearings seated in steel V-block saddles. Each of the large pedestals is equipped with a gravity-flow drip lubricating system.

The sine-wave generator is mounted on a separate base independent of the armature supporting structure. Its metal enclosure houses a V-S drive which, through V-belt connection to the generator shaft, provides a range of operating speeds up to about 3,000 rpm. The generator shaft is coupled to the shaft of the rotor in the balancing saddles. When small armatures are to be balanced, the V-S drive provides the motive power. Large rotors are driven by a separate motor and V-belts.

Prime function of the sine-wave generator is to determine the angle (or position) of unbalance on the rotor. This is done by simply turning a large knob on the end of the generator housing (which rotates permanent magnet field) until the meter needle points to zero on the

SMALL ARMATURES are balanced in H-frame pedestals with trapeze type saddles. Rotor is coupled to shaft extension of sine-wave generator and driven by V-S drive under generator. Dynetric pickups (arrows) transfer lateral movement of saddles into electrical impulses which register on meter as units of unbalance.

. . . here's a tip for **MOTOR REPAIR MEN** *from* GENUINE JOE

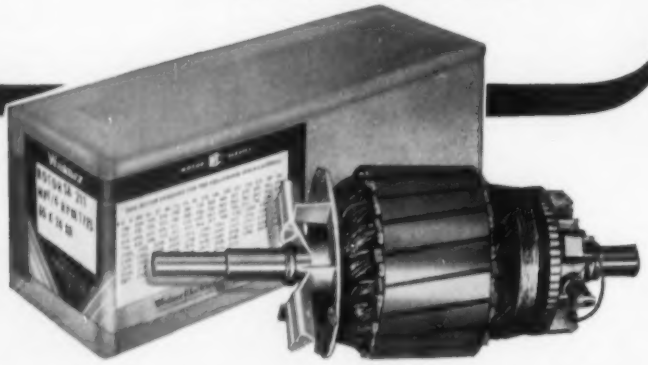
YOU CAN SAVE MONEY

and rewinding time

if you use

Wagner STANDARD ROTORS

on small motors



The next time a rotor on a small motor needs servicing, don't rewind it . . . *replace* it with a Wagner Standard Rotor. This way, your winders stay free for bigger and more profitable jobs.

There's no problem with special shafts. You can easily remove the shaft from the Standard Rotor and replace it with the special one.

And there's no guesswork in finding the rotor you need for your motors. Wagner K and M "spec" lists, when used with the "tell-all" label on the rotor package, assure the right choice every time. You'll find the "spec" lists in Catalog MU-40 which is yours for the asking—so write today.

It's wise to stock Wagner Replacement Motors

Smart motor repairmen always carry a stock of Wagner Replacement Motors. They come in handy for emergency use when your customer needs immediate service, and they're easy to sell as replacements for motors "too far gone" for repairs.

WAGNER ELECTRIC CORPORATION
6413 Plymouth Ave., St. Louis 14, Mo., U. S. A.

Wagner Electric Corporation

MOTORS · BEARINGS · STANDARD ROTORS
BRUSHES · CAPACITORS · COMMUTATORS

OVER 850 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS

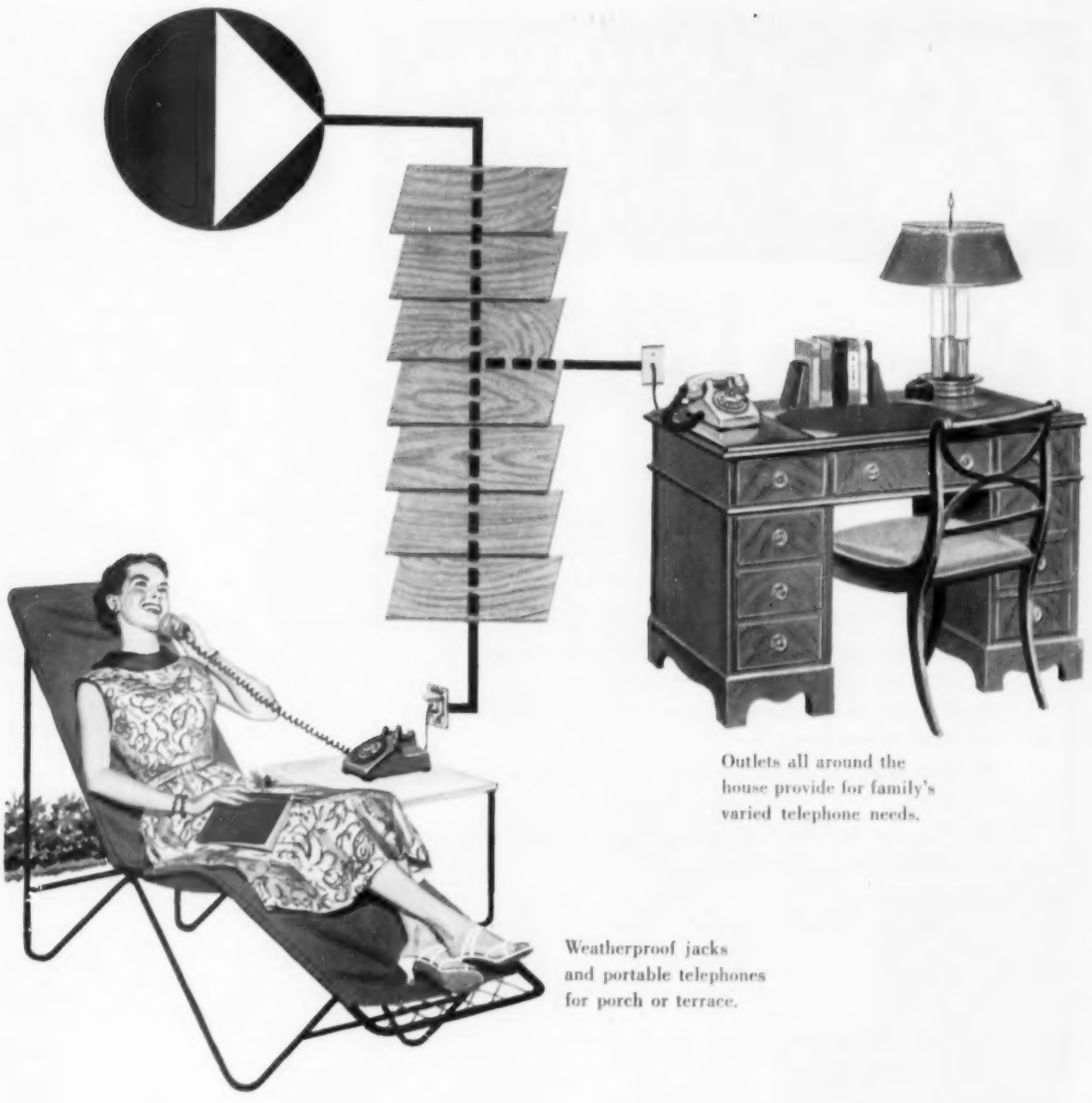
MS56-3

TO DETERMINE ANGLE of unbalance, assistant shop superintendent Harry Wetmore adjusts sine-wave generator knob until meter pointer registers "zero". Angle of unbalance is read from calibrations (degrees) on generator knob.

READINGS ARE PLOTTED on circular graph. Analysis of resultant vectors shows how much weight must be added to rotor at a point diametrically opposite that shown on graph. Sequence is repeated for each end of rotor under test.

scale. A reading on the knob, calibrated in degrees, gives the angle of unbalance. This adjustment is made while the rotor is spinning at required speed and constitutes the first step in the balancing sequence.

Actual magnitude (or amount) of unbalance is provided by the Dynetric pickup bracket-mounted at shaft level on each pedestal. Metal probes extend through the pedestal frame and make contact with one edge of the free-moving trapeze saddle. Any lateral movement of the saddle causes the probe to pulsate back and forth in the horizontal magnetic field of the pickup. These pulsating movements are transmitted as electrical impulses to the meter and register as movement of the meter needle. Thus the amount of unbalance can



Outlets all around the house provide for family's varied telephone needs.

Weatherproof jacks and portable telephones for porch or terrace.

Few home features mark your thoughtful attention to detail so convincingly, in the eyes of home buyers, as (1) concealed telephone wiring and (2) conveniently located telephone outlets.

BELL TELEPHONE SYSTEM

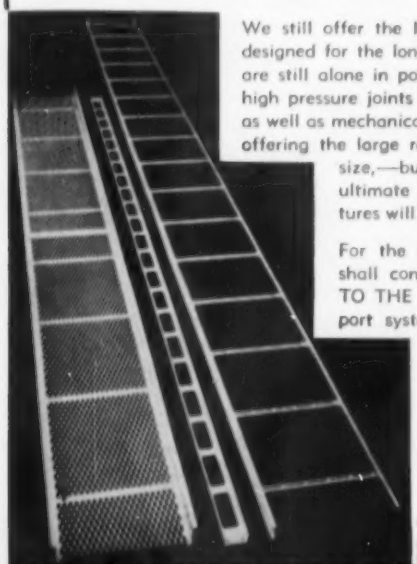
Your Bell telephone company will be glad to help you plan economical concealed wiring installations. Just call the nearest business office and ask for "*Architects and Builders Service.*" For details on home telephone wiring, see Sweet's Light Construction File, 8i/Be. For commercial installations, Sweet's Architectural File, 32a/Be.

ALUMINUM
OR GALVANIZED STEEL
SUPPORT SYSTEMS
FOR POWER AND CONTROL CABLES
IN-FREE-AIR
DESIGNED AND DEVELOPED BY HUSKY PRODUCTS

We are followed

We are proud to be considered the leaders in our field. We specialize in electrical cable support systems and are slowly followed by all others in:

1. The longer lengths we pioneered for field labor savings.
2. The slip-on expanded metal splices originated by us for lower erection costs.
3. The use of structurally sound racks with fully inserted and welded rungs.
4. The principle of designing for long spans to save supports.
5. The use of aluminum to reduce the "installed cost" and give a "maintenance free installation."



We still offer the longest racks, troughs and baskets designed for the longest spans and heaviest loads. We are still alone in pointing out the great importance of high pressure joints for splices to give sound electrical as well as mechanical connections and are also alone in offering the large radii fittings suitable for any cable size,—but hope that, for the benefit of the ultimate user, these and all our other features will also soon be copied.

For the convenience of our customers we shall continue to feature the "COMPLETE TO THE LAST BOLT" electrical cable support system including time-saving installation tools, will continue to help the contractors with lay-outs, take-offs and erection diagrams and will continue to excel in delivery and service rendered. "HUSKY DOESN'T COST—IT PAYS."

AVAILABLE THROUGH LEADING CABLE MANUFACTURERS

HUSKY PRODUCTS, INC.

5300 VINE STREET, CINCINNATI 17, OHIO

be read from the meter scale as units of unbalance. This is the second step in the balancing sequence. A positioning switch at the meter permits the operator to insert first one and then the other pickup into the meter circuit.

The third step consists of plotting the information on a circular graph and analyzing the vectors obtained. Suppose, at zero meter reading, the sine-wave generator knob indicated 60 degrees; and the pickup circuit swung the needle over to No. 4 on the meter scale. Then "4" at 60 degrees would be plotted on the graph and a counterweight would be added to the rotor at a point diametrically opposite that indicated on the graph.

The same procedure would be repeated at both ends of the rotor until the unit was in perfect dynamic balance.

When taken into the field, the sine-wave generator is securely mounted on a tripod support with adjustable legs and a rack and pinion bracket to bring the generator shaft in alignment for coupling with the rotor shaft. The meter, pickups and connecting cables are carried in a portable case.

Biggest advantage of this specific method, according to California Electric Co. personnel, is the marked reduction in time required to balance a rotor. Sensitivity of the pickups provides a high degree of accuracy, even when balancing must be done at relatively low speeds. Add to this the portability of the generator, pickups and meter equipment and the CECO design bears the stamp of an all-purpose dynamic balancing unit that fits the needs of most motor repair shops.

Dual-Position Commutator Undercutter

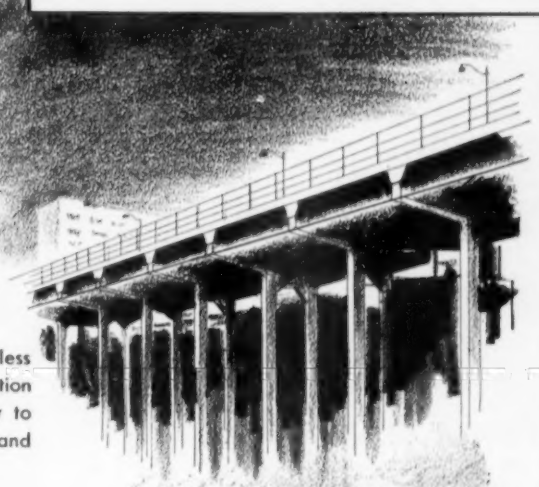
Commutators of either the horizontal (parallel to motor shaft) or vertical (right angles to motor shaft) type can be undercut with equal ease on a dual-position machine designed and built in the motor repair shop of the K & N Electric Company in Spokane, Wash. Contrary to conventional design, the undercutter shaft assembly in the K & N unit remains stationary and the armature moves back and forth by means of a hand lever mechanism.

A 26-in. length of inverted 4-in. steel channel provides the basic support for the armature holder. Two end brackets, each 7 in. high and

what you should know about HAZARD SELF-SUPPORTING CABLE

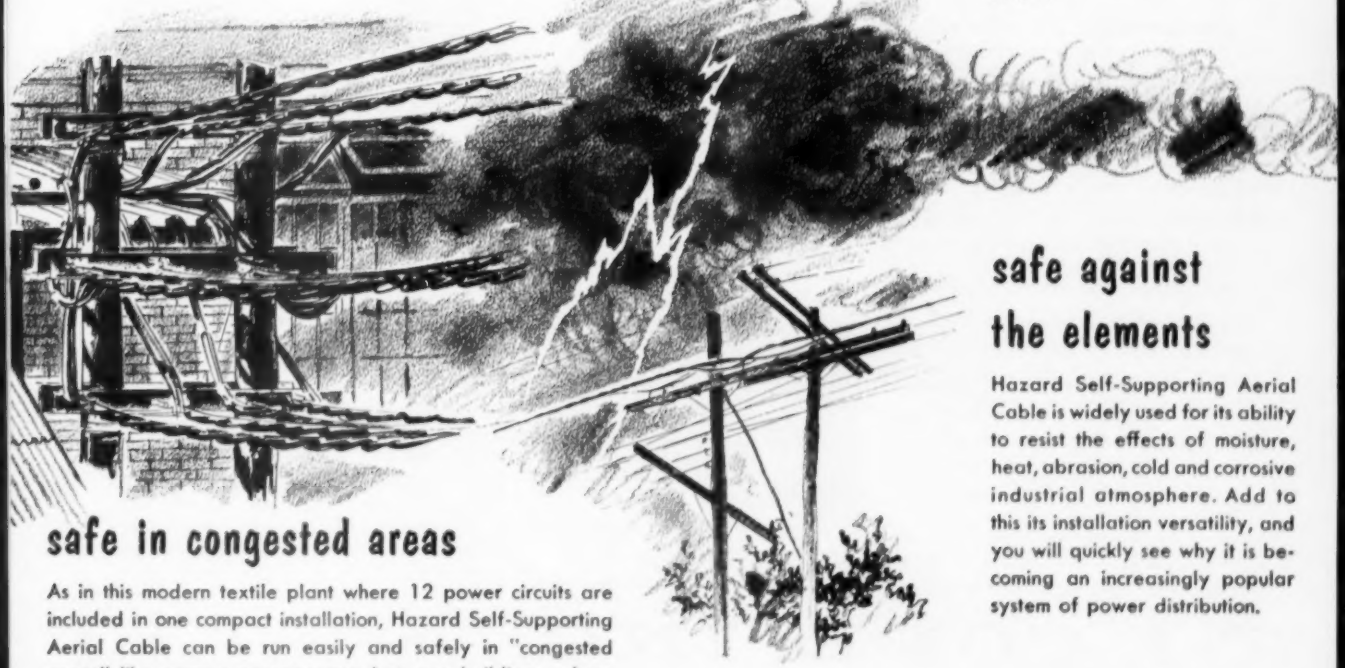
installation costs are low

. . . surprisingly low. In many cases, far less than for open wire construction. Installation costs are low because the cable is easy to work, splice and terminate. Maintenance and tree trimming costs are greatly reduced.



uses existing construction

When you need power in a hurry —can't spare the time or expense to buy conduit or erect special poles and towers—your wisest choice would be Hazard Self-Supporting Aerial Cable. It can be strung along the sides of buildings, under bridges or viaducts, on existing poles and towers or on almost any structure between power source and point of use.



safe in congested areas

As in this modern textile plant where 12 power circuits are included in one compact installation, Hazard Self-Supporting Aerial Cable can be run easily and safely in "congested areas" like narrow passageways between buildings, where trees are a problem, where the aerial approach is already crowded or on poles and towers too full for another bare circuit. With its superior insulation, flashovers and danger to personnel and property are effectively minimized.

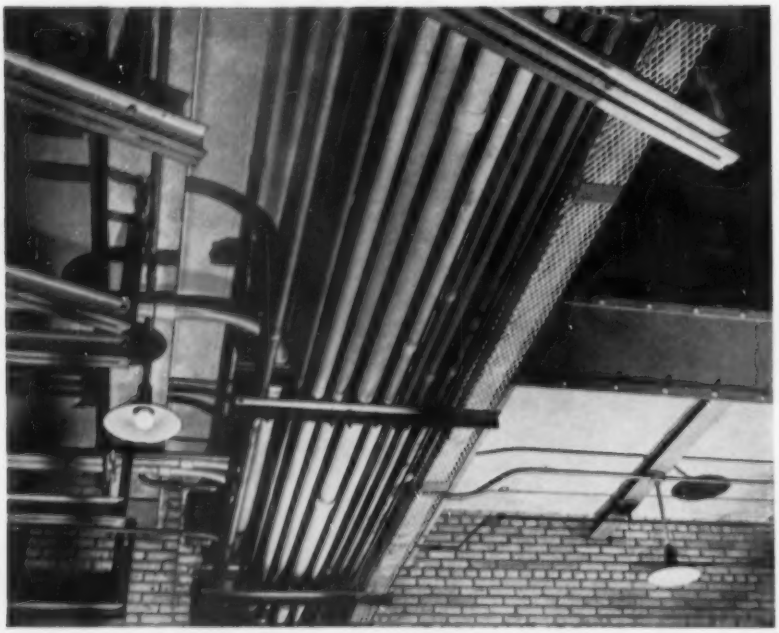
safe against the elements

Hazard Self-Supporting Aerial Cable is widely used for its ability to resist the effects of moisture, heat, abrasion, cold and corrosive industrial atmosphere. Add to this its installation versatility, and you will quickly see why it is becoming an increasingly popular system of power distribution.

Complete information on Hazard Self-Supporting Aerial Cable is available in the free Bulletin H-464. Hazard Division of The Okonite Company, Passaic, N. J.

3651

HAZARD PRODUCT OF OKONITE RESEARCH INSULATED CABLES



Jersey Central Power & Light Co., South Amboy, N. J. Burns & Roe, Engineers.
The Cope Cable Trough shown above carries as much cable as all of adjacent system.

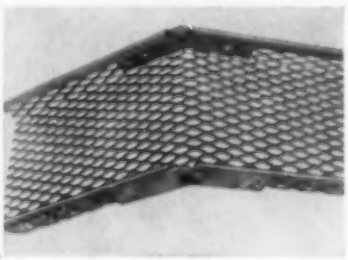
Jersey Central Power & Light Company Cuts Costs with Cable Trough

The great space saving possible with Cope Trough is dramatically illustrated at Jersey Central Power & Light Company's South Amboy installation of cable supports. Where space is at a premium, specify Cope Cable Trough.

SAVE LABOR during installation. Cope Cable Trough with the exclusive Pin-Type Coupler goes in faster than any other trough system. Standard fittings are available for virtually any connection, corner, awkward space—yet fewer individual pieces are needed and installation time is greatly reduced.

SAVE MATERIALS with Cope Cable Trough. You support far more cable with the same weight of Trough than with any competing system—and steel is costly.

Elevation changes are simple with Cope Trough. Edges of the Trough may be cut readily and standard fittings insure rigid support.



Our engineers are ready to work with you. Write us today for full details on new 70,000 Series.

T. J. COPE, INC.

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Cope

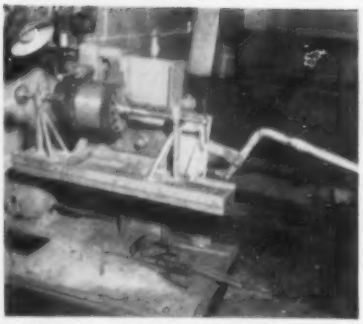

GROUND TENTS


ROD GRAPPLES

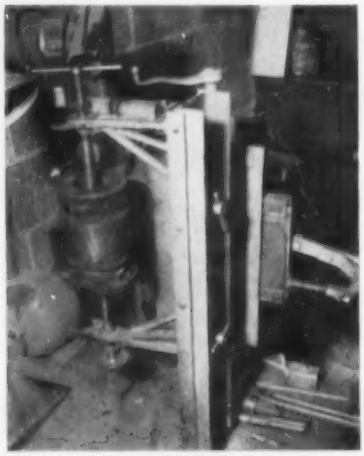

CABLE REEL JACKS


WARNING SIGNS


CROSS ARM SHEAVES



ADJUSTABLE UNDERCUTTER permits armature to be moved slowly back and forth while rotating blade cuts mica between commutator bars. Lever handle at right moves armature support assembly.



VERTICAL POSITION of armature support is used when commutators are at right angles to motor shaft. Same back and forth motion (left to right) results from pumping lever arm on slide mechanism. Fan at top blows mica particles away while cutter blade turns.

equipped with adjustable cone centers, actually hold the armature shaft. V-slots at the top of each bracket accommodate armatures with shafts too long to fit between the centers. Each bracket is welded to a 7¼-in. by 4-in. base plate made of ⅜-in. steel. The plates have a 4-in. by ½-in. slot for a through-bolt with wing nut to lock the brackets securely in place and provide the necessary lateral adjustment for shafts of different lengths. Side flanges, bolted to the channel, seat the bracket plates.

The complete armature bracket assembly is mounted to a heavy steel, horizontal slide mechanism operated by a hand lever. This, in turn, is mounted to a steel collar which rides up and down a 22-in. high pedestal of 6-in. I-beam welded to a heavy metal base plate bolted to a 22-in. by 20-in. wood table. Vertical adjustment for undercut-

Section of the executive offices White Motor Co., Cleveland, Ohio. Architect, Dalton-Dalton & Associates. Contracting electrical engineer, Anton Eichmuller. Electrical contractor, Hatfield Electric. "Lucite" extruded by The Southern Plastics Co., Columbia, South Carolina. Recessed luminaires by The Wakefield Co., Vermilion, Ohio.

Better looking., better lighting

with diffusing panels of Du Pont LUCITE®

The new offices of the White Motor Company in Cleveland have been designed to combine high functional efficiency with unusual attractiveness. As far as lighting is concerned, diffusing panels of "Lucite" play an important role in this "dual-purpose" design.

Diffusing panels of extruded "Lucite" acrylic resin transmit optimum light without specular glare or shadow. They are strong, durable, free from discoloration, and dimensionally stable. Installation is a simple matter. Panels of "Lucite" are light in weight and easy to handle.

Extruded "Lucite" can be formed readily into desired shapes and is available in a wide range of transparent and translucent colors. For further information on how you can incorporate "Lucite" into your lighting designs write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 532, Du Pont Building, Wilmington 98, Delaware.

Quality Controlled

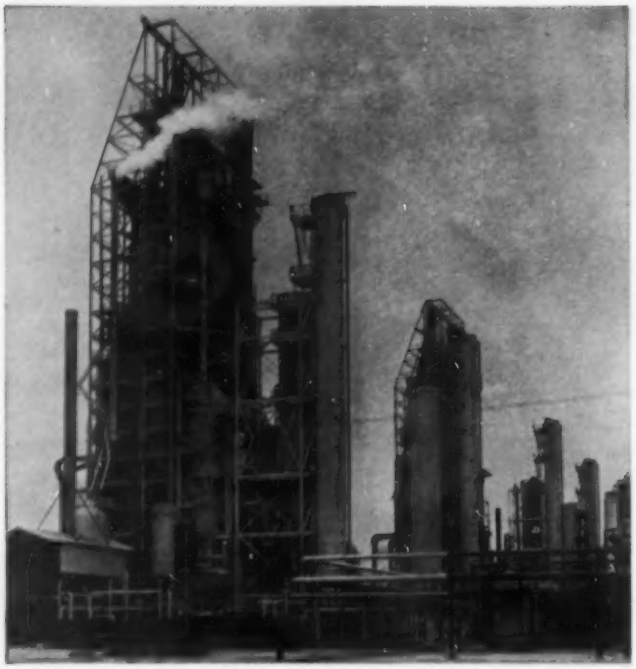
This "Quality Controlled" label may be used only by qualified extruders of Du Pont "Lucite" acrylic resin. It assures the lighting industry that the extruded material conforms to standards for low shrinkage and uniform caliper established by E. I. du Pont de Nemours & Co. (Inc.).

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

ADV.



1. Throughout the General Petroleum Corporation plant, the heat and corrosion resistance of Rome Synthinol 901 helps protect vital control circuits. This refinery produces a full range of petroleum products and many by-products in chemicals and gases.

To get the best in

INDUSTRIAL WIRING

look for acceptance by critical users

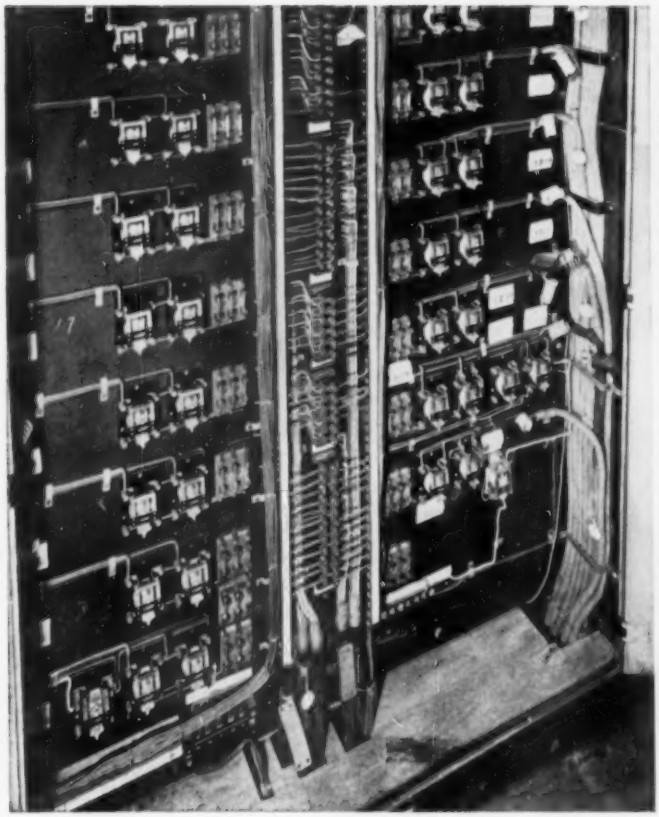
Compared to the cost of shutdowns, the *best* equipment and materials cost little whether in refineries, steel mills or most any manufacturing operation. That applies particularly to remote control circuits.

General Petroleum Corporation, Torrance, California has specified Rome Synthinol® Control Cables. The tough Rome Synthinol 901 (polyvinyl chloride) insulation resists high temperatures, moisture, oils, corrosive chemicals or fumes. The protective Rome Synthinol sheath permits installation in conduit or ducts, directly in earth or aerially.

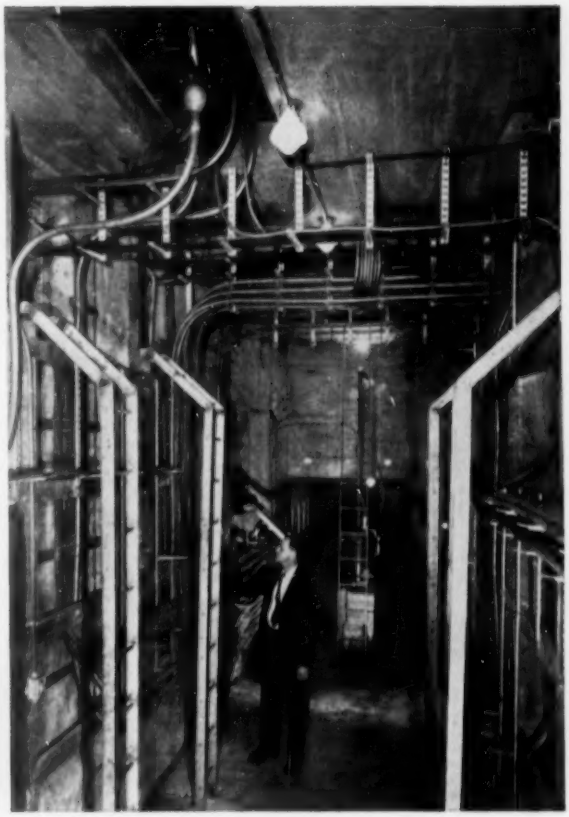
Consisting of as many as 25 individual conductors of 16 AWG, assembled with a 12 AWG common return, these cables assure the customer of trouble-free operation. Because of its high resistance to environmental hazards Rome Synthinol 901 insulation provides long-time protection for individual conductors when fanned out for terminations. Clear and permanent color coding assures proper circuit identification.

Rome Synthinol 901 insulation provides that extra

2. Installed in the terminal box for this 200 hp water pump, Rome Synthinol 901 gives extra heat and corrosion protection to start and stop push-button, high pressure alarm, high-level alarm, and low-level alarm circuits.



3. A substantial quantity of multi-conductor Rome Synthinol Control Cables was used to connect plant areas with 16 motor control switch houses.

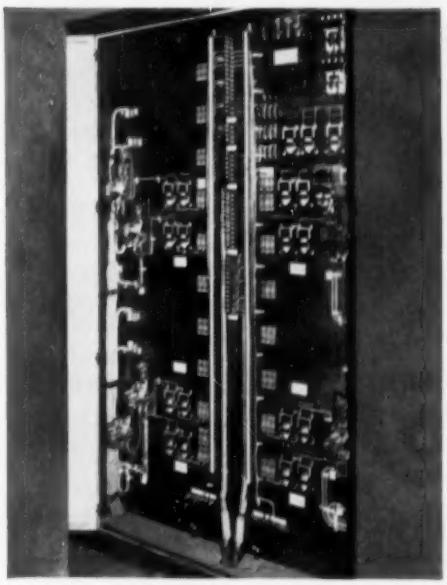


4. One of the pressurized and temperature controlled underground cable distribution vaults with tunnels going off to left and right.

margin of safety which costs so little in the long run. Its long-time dependability has made it the preference of such critical users as refineries, chemical processors, paper and steel mills.

If you have a control circuit problem, it will pay you to check on the economy and dependability of Rome Synthinol Control Cables. Rome engineers will gladly study your requirements. Write or phone your nearest Rome Cable office.

It Costs Less to Buy the Best



5. One of the 2400-volt motor control relay panels wired with Rome Synthinol Control Cable. Permanently clear color coding makes circuit identification positive, easy.

ROME CABLE Corporation
ROME · NEW YORK
and
TORRANCE · CALIFORNIA

When is adequate wiring

...really adequate?

Heavier wiring is not the *complete* answer to adequate wiring. You must be able to *use* the wire to its full, safe current carrying capacity. That means you should not have to *derate* your circuits.

Derating simply subtracts from your usable electrical capacity. It's a means of allowing for changes in performance of many circuit protectors when they're warm. But, the rating of HEINEMANN CIRCUIT BREAKERS never changes.

Hot or cold, Summer or Winter, you enjoy the full safe use of your wiring system. Derating—under any conditions—is eliminated.

When you specify HEINEMANN CIRCUIT BREAKERS, you make sure that "adequate" wiring will always be *really* adequate . . . and safe.

Send for your copy of Manual 101, "What you should know about circuit breakers."

HEINEMANN
ELECTRIC COMPANY
132 Plum Street, Trenton 2, N. J.
Circuit breakers

BACK VIEW of supporting pedestal showing lever and slide mechanism, vertical adjustment hand screw and V-belt motor drive. Hand screw raises or lowers commutator to cutting blade height.

ting depth is provided by a hand screw assembly on pedestal support.

A stationary bracket, bolted to the top of the I-beam pedestal, supports the shaft of the circular cutting blade. High speed operation of the cutter is provided by a V-belt connection between the shaft and a ½-hp, 110-volt, single-phase motor mounted to the pedestal base plate.

Mechanics in the K & N shop point out two specific features of their dual-position undercutter. It saves considerable time and it is easy to operate. Once the armature is placed in the holding bracket, it is raised or lowered to cutting blade height by simply turning the hand screw on the pedestal support. The mechanic starts the motor and moves the armature back and forth by slowly pumping the lever handle on the slide mechanism. While the blade is undercutting the mica between the commutator bars, a continuous blast of air from a small squirrel cage fan, on top of the pedestal, blows the mica filings away and provides a clear view of the commutator. A concentrated beam of light from a gooseneck reflector highlights the copper bars and facilitates alignment of cutter blade and mica slots.

Normal position of the armature holder is horizontal when undercutting horizontal-type commutators. If the commutator is at right angles to the armature shaft, the entire armature bracket assembly is rotated 90 degrees and locked in vertical position. The previously described undercutting procedure is repeated. Before the dual-position machine was built, vertical-type commutators were undercut by hand.

In Taconite processing plant, ANACONDA Interlocked-armor cable is used for feeder line . . . resists weather and industrial hazards.

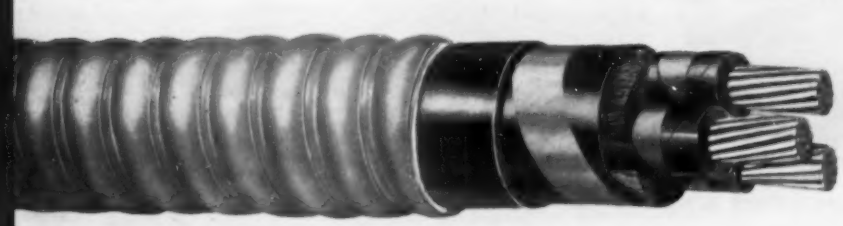
New cable puts power where you want it—fast!

With ANACONDA Interlocked-armor cable you bring power to new load centers faster—change plant layout quickly, or add new facilities in a hurry!

It is economical—installed fast—indoors or out—with simple supporting devices . . . trained easily around corners, columns and other obstructions in long unbroken runs. Circuits are easy to relocate . . . always accessible. And this cable's interlocked metal-tape armor affords high mechanical protection against all types of damage.

The Man from Anaconda, or your nearest Anaconda distributor, will be happy to give you full information. Or write to: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York. 6020B

ASK THE MAN FROM ANACONDA® FOR INTERLOCKED-ARMOR CABLE

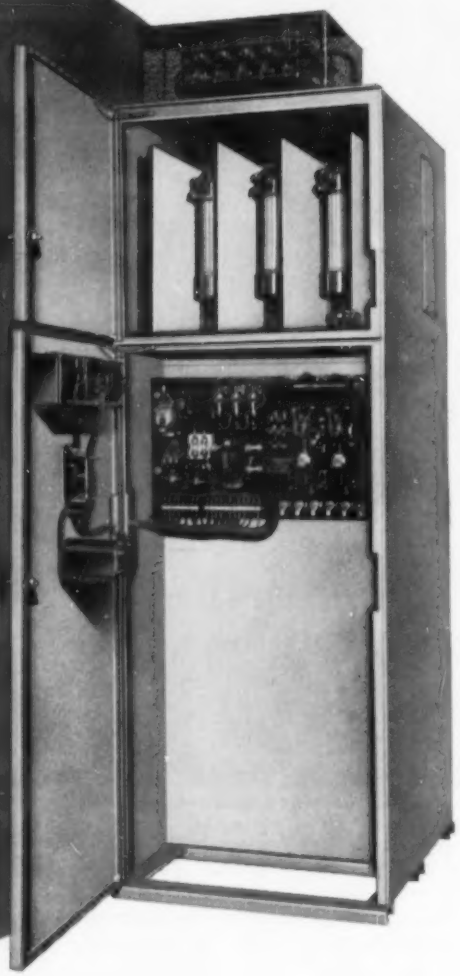


Anaconda Interlocked-armor cable comes in sizes No. 6 Awg to 750 Mcm—copper or aluminum—up to 15 kv—Underwriters' approval for 600 volts and 5000 volts. Available with rubber-, plastic- or varnished-cambric-type insulation.

Allis-Chalmers offers a complete line of

MOTOR CONTROL

Small ... Large and all sizes in between



The Allis-Chalmers line extends from small manual starters for fractional horsepower motors through starters applied in controlling up to 2500-horsepower motors. Built into every control is the type and degree of protection required to meet your specific needs. Control functions, varying with application, include full or reduced voltage starting, acceleration, speed control, reversing or non-reversing, and dynamic braking.

Application Help

An Allis-Chalmers recommendation is backed by the experience gained in solving thousands of control application problems . . . by complete research and testing facilities. Get all the facts. See your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4722

ALLIS-CHALMERS

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  Use second line of boxes. Insert item numbers of literature desired.

- **ADVERTISEMENTS:**

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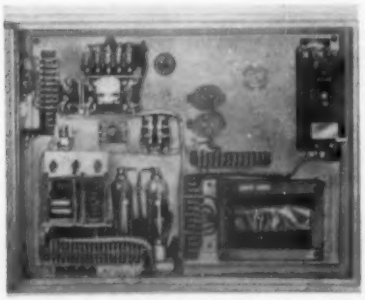
Product News

Limit Switches (1)

Two new limit switches are available for machine-tool and general purpose applications. One, the new Type PLS lever-operated limit switch may be adapted for clockwise, counterclockwise, or universal operation by the turn of a screw selector. A companion switch, the Type PRS limit switch is actuated by depressing a push rod. Both switches are available for flush or projection mounting, both contain normally open and normally closed snap-action contacts, and both have identical electrical characteristics. Normal ac current ratings range from 15 amps at 115 volts to 5 amps at 600 volts, maximum dc current ratings from 2.0 amps at 115 volts to 0.1 amps at 600 volts.

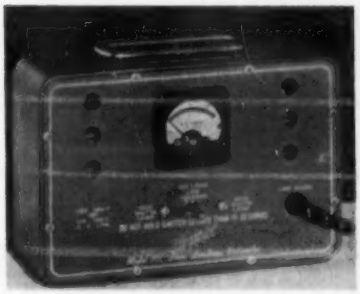
Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.



Electronic Control (2)

A new electronic control, designed particularly for the requirements of variable speed machine tool drives. Control can be preset for specific spindle speeds, or supervised by mechanical or electrical means to provide continuously variable spindle speeds, in applications where constant lineal speed is needed at tool tips or grinding face. It provides a flexible means of automating machine processes common to many industries. The control unit provides two fullwave thyratron rectifiers; one to supply and control power for the drive motor field; and the other for similar armature service. Electronic motor controls are supplied as complete metal clad switchgear for connection to 220/440-volt ac lines. Tubes and associated electronic components are panelboard mounted. Circuit sections are of modular design to permit interchange for maintenance without interruption of machine operation.

Federal Pacific Electric Company, 50 Paris St., Newark 1, N. J.



Instrument (3)

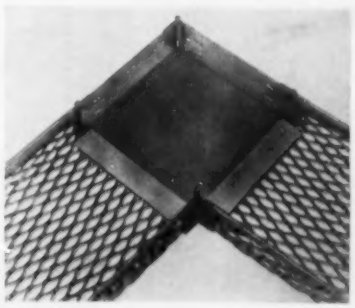
New line loading voltmeter, identified as Model 101. This portable instrument plugs into a standard 115-volt outlet and continuously reads line voltage. A built-in front panel switching arrangement permits 1000-watt or 2000-watt line load and reads resulting ac line volt change due to load. Field service and electrical unit installers use this equipment to determine circuit capacity and adequacy of existing wiring to handle air conditioning units, freezers and other major appliance installations in homes or institutions.

Hickok Electrical Instrument Co., 10553 Dupont Ave., Cleveland 8, Ohio.

Plug Fuses (4)

"Slo-Lag" plug fuses, designed to absorb the temporary overload caused by the starting of motors. They have a thermal element which absorbs the temporary overload and protects against dangerous overloads and short circuits. They are available in 15-, 20-, 25-, and 30-amp sizes and are made with a shockproof glass top. They are listed by Underwriters Laboratories.

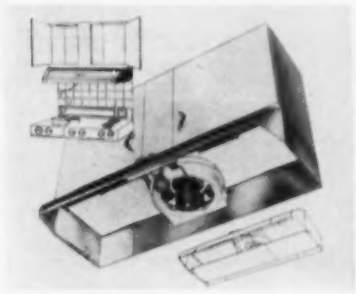
Eagle Electric Mfg. Co., Inc., 23-10 Bridge Plaza South, Long Island City 1, N. Y.



Connector (5)

A simplified coupling for cable trough speeds installations. The new connector secures the two coupler blanks with a simple pin that drops in place. Pin can readily be removed should future changes or expansions be needed. The pin-type coupling reduces the number of pieces required for one connection from 13 to 3. Nuts, bolts, and washers are replaced by only 2 pins. The joint is completed with a plate that fits both over and under the bottom of the trough.

T. J. Cope, Inc., 711 South 50th St., Philadelphia 43, Pa.

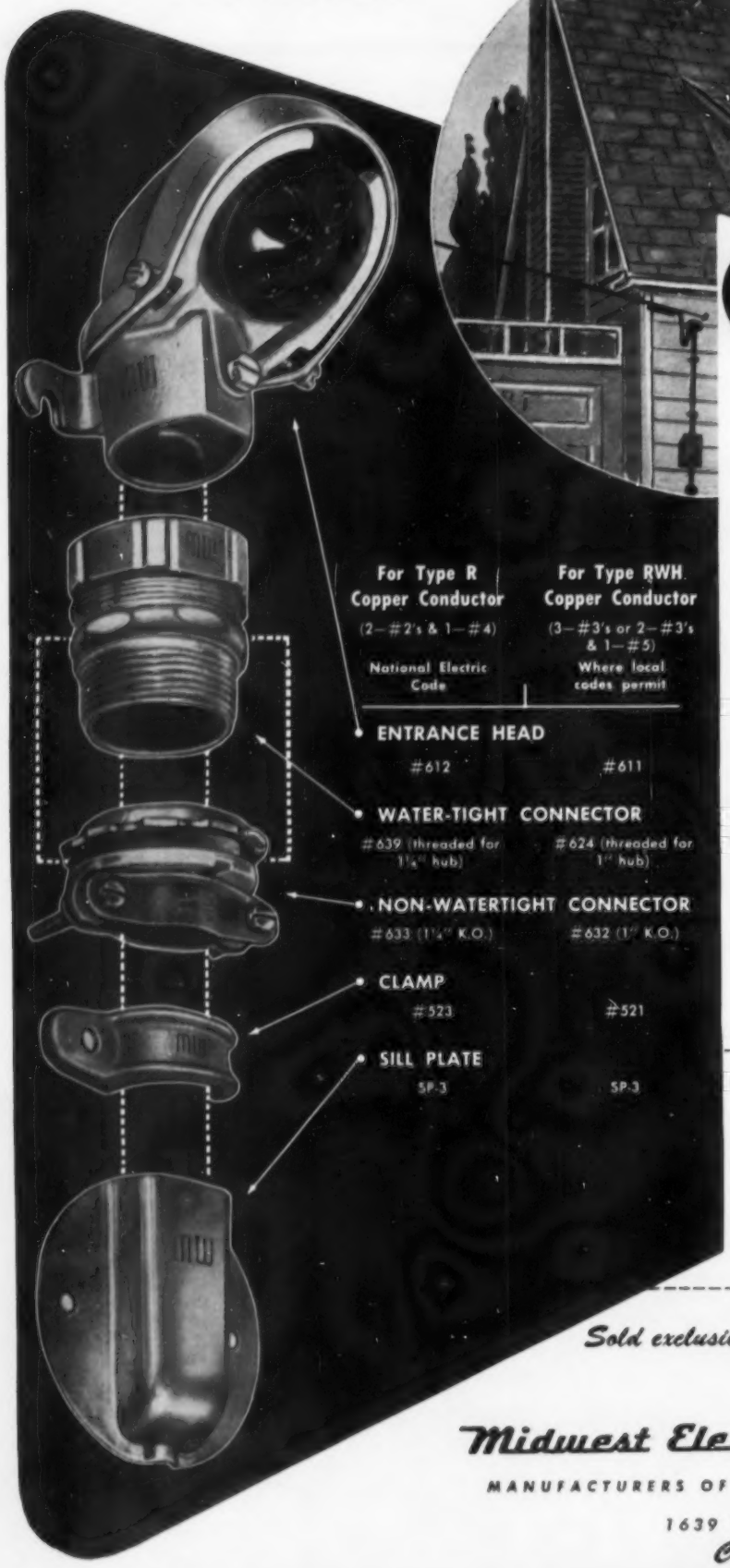


Ventilator (6)

New ventilator that is completely contained in a modern adjustable hood, called Powerhood. It has snap-in ventilator attached to the underside of the hood. There is no loss of cabinet space due to ventilator or duct installation. High efficiency impeller wheel, pushbutton controls and underhood light come ready installed on Powerhood, with all working parts concealed. It adjusts to fit the underside of any cabinet or row of cabinets from 30 in. to 42 in. long. Ventilator is pre-wired before it leaves the factory. Inserting six screws and connecting the BX to the receptacle is all that is needed. On the face of Powerhood is pushbutton panel which offers fingertip control of unit's three speeds (ultra high, normal and low).

Fasco Industries, Inc., Rochester 2, N. Y.

midwest FITTINGS ····



	For Type R Copper Conductor (2—#2's & 1—#4) National Electric Code	For Type RWH Copper Conductor (3—#3's or 2—#3's & 1—#5) Where local codes permit
ENTRANCE HEAD	#612	#611
WATER-TIGHT CONNECTOR	#639 (threaded for 1¼" hub)	#624 (threaded for 1" hub)
NON-WATERTIGHT CONNECTOR	#633 (1¼" K.O.)	#632 (1" K.O.)
CLAMP	#523	#521
SILL PLATE	SP-3	SP-3

···· FOR YOUR 100 AMP SERVICE REQUIREMENTS— USING SERVICE ENTRANCE CABLE

• Here is an index of Midwest Catalog items, designed to meet your specifications for fast and rugged installations of modern 100 amp service entrances — using service entrance cable.

• This is a convenient guide to help you in selecting materials for these special installations.

●

UTILITIES

Our engineers have worked with utilities in various areas of the country in developing fittings for entrance cable. We invite your inquiry whether it involves copper or aluminum conductors.

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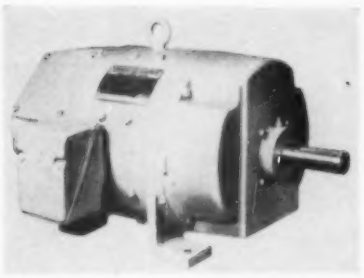
Chicago 12, Illinois



Motors and Generators (7)

A completely new line of dc motors and generators, known as Kinamatic, has been designed for versatility of application and performance. Speed is adjustable by armature voltage control, field strength control, or any combination of both. Higher base speeds are available and higher top speeds may be obtained by field strength adjustment. Kinamatic motor can operate at any speed below base, including stalled torque. All standard Kinamatic motors and generators have dripproof enclosure and are supplied with a guaranteed 15% service factor. Class B insulation is supplied throughout. Many new features have been incorporated into the line for easier maintenance. Smooth, streamlined design gives the motor a modern, rugged appearance. All ratings and accessories are available from one to 150 hp and ¾ to 100 kilowatts.

General Electric Co., Erie, Pa.

Electronic Oven (8)

Ultra-high frequency, high speed cooking and baking becomes available to the home with a new electronic cooking device. Resembling a large built-in wall oven, unit consists of two sections: an upper oven where 2,450-megacycle current cooks and bakes food in seconds and minutes; and a lower oven equipped with conventional Calrod units for browning. Unit operates on a conventional 118/236-volt, 60-cycle standard range service. Door switch and timer operate at 118 volts. The 236 volts go into a power supply consisting of a power relay tube, three transformers and four rectifier tubes which change it to 4,800 volts pulsating dc. The pulsating dc goes to a magnetron tube, then into a wave guide and stirrer and emerges in top oven as ultra-high frequency (2,450 megacycles) current. The electronic components require 850 watts; the browning oven below, 4,500 watts.

Hotpoint Company, 5600 West Taylor St., Chicago 44, Ill.

Instrument (9)

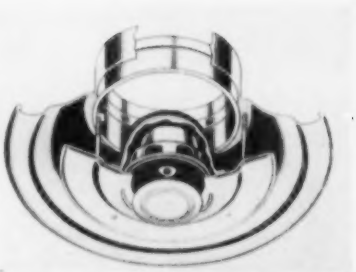
A new volt-ohm-milliameter, Model 555A, with meter movement protection up to 500 times overload. Designed for easier servicing and reliable performance, it features only two jacks for all measurements, separate range and function switches and an insulated zero adjustment. 43 unduplicated ranges provide a lower ratio of ranges. Scales are color-coded. The 555A measures: dc volts from 1.5 to 1500 volts at 20,000 ohms per volt; ac volts from 1.5 to 1500 volts at 2,000 ohms per volt; dc current from 50 UA to 15 amps; ac current from 1.5 MA to 15 amps; decibels from minus 10 to plus 50; resistance from .25 ohms to 10 megohms. Literature is available.

Phasotron Instrument and Electronic Co., 151 Pasadena Ave., South Pasadena, Calif.

Motor (10)

A new heavy duty "Type F" (Synchron) motor is now used on all astronomic, program, poultry and switchmaster time switches. Motor has a temperature range of minus 40° to plus 140°F, enabling it to operate efficiently in both extreme cold and warm locations. It is dust-proof and will operate in any position. "Type F" is suitable for use in cold freezer compartments, and in warm compressor rooms. Its sealed and fully protected coil assures superior results where humidity and moisture from outside air or air in compressor rooms might affect switch motors.

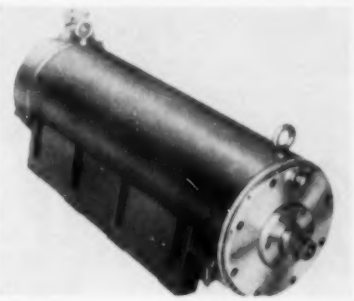
Tork Clock Co., Inc., Mount Vernon, N. Y.



Speaker and Air Diffuser (11)

Where public address or wired music systems and air outlets are required in the same space, one ceiling opening now served for both with a new combined loud speaker—air diffuser unit. Speaker unit is completely concealed within the circular diffuser and air discharge around the former does not affect sound quality. Ceiling diffusers are usually centered in the ceiling for even air distribution; in the combination unit the sound source enjoys the same central location. Air diffuser - loud speaker is made in several sizes, with or without damper, to handle various air volumes. It will accommodate any extended range 8-in. speaker.

Connor Engineering Corp., Danbury, Conn.



Motor (12)

A new moisture-, dust-, and explosion-proof electric motor for mechanical drive applications. This mechanically sealed motor was especially developed for mining, dry milling, cement processing, aviation, chemical industries and other similar applications where it is necessary to operate electric motors in explosive or corrosive atmospheres. The entire motor is enclosed in a steel case filled with mineral oil of high dielectric strength. This oil-filled motor can be supplied to meet special torque requirements of particular applications as well as special horsepower and speed requirements. Terminal boxes can also be supplied for use with special power cable which may be required for a specific installation.

Byron Jackson Pumps, P. O. 2017A, Terminal Annex, Los Angeles 54, Calif.

Revere
ELECTRIC MFG. CO. CHICAGO, U.S.A.

HINGED POLES
...and 4200 Series FLOODS

Serve O'HARE International

... a combination that has already saved hundreds of dollars in maintenance time. The floodlights can be serviced from the ground (thanks to Revere Hinged Poles). The lighting system can be put back into service in a fraction of the time required when floodlights are mounted on Rigid Poles.

Revere will gladly go over your lighting problem and offer a complete package deal from Runway Markers, Code Beacons, Obstruction Lights—to Apron and Parking Area Lights. Revere manufactures a full line of outdoor lighting equipment for all requirements.

Write today outlining your plans.
This places you under no obligation.

REVERE ELECTRIC MFG. CO. • 6009-17 BROADWAY • CHICAGO 40, ILL.
Available in Canada thru Curtis Lighting, Ltd., Leaside, Toronto, Ontario

THE ONLY COMPLETE LINE OF LUMINAIRES • FLOODLIGHTS AND POLES FOR STREET, SPORTS, AIRPORT, SERVICE STATION, OUTDOOR THEATRE, MARINE AND INDUSTRIAL LIGHTING

Pipe Bender **(13)**

Pipe bends up to 90 degrees can be made in one setting of the pipe and one stroke of the ram with the new S-130 "One Set" hydraulic pipe bender. It has a bending frame, swivel and bending shoes made of rigid, lightweight aluminum. Removable top plate permits easy setting of shoes and positioning of pipe for bending. By removing the top plate, pipe can be inserted from top and bending job accomplished. The bender will work in any position—on the floor, on a table, or overhead on existing runs. Features in the unit is the "Optik Angle Gauge", which permits the operator to have visual control of progress of bend with every pump stroke. Six cast aluminum bending shoes handle ½, ¾, 1, 1¼, 1½, and 2-in. diameter pipe or conduit. Shoes are set on plunger and a lock pin dropped into place. A remote-controlled hydraulic power unit gives bender versatility as a maintenance jack.

Blackhawk Manufacturing Co., 5325 W. Rogers St., Milwaukee 46, Wis.

Fluorescent Luminaire **(14)**

A new line of fluorescent luminaires for commercial and institutional applications. Known as Type PB luminaires, the units may be obtained in 2- and 4-lamp models, in 4- or 8-ft lengths, for mounting in continuous rows or individually, and for rapid start or slimline lamps. Through the combined effect of suspension mounting, a strong upward light component, and a ribbed translucent plastic bottom, the PB luminaires provide soft, glare-free, semi-indirect lighting. Each unit consists of a completely wired steel channel, fitted with ETL ballasts; a removable channel cover; and an extruded one-piece polystyrene shield.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

This could be you—"In the Land of No Distributors."

Got an emergency? Want a switch in a hurry? Or some connectors? How about wire? "In the Land of No Distributors" there are no "over-the-counter" purchases and *hurry* is an unknown word. "In the Land of No Distributors" you couldn't pick up the phone nor could you send Harry or Mike out in the truck to pick up emergency requirements. If the switch or connector or cable manufacturer is in East Hoboken and you happen to be in Chicago you either wait a week or ten days or you make a flying visit to East Hoboken.

Not once, but many a day (and night).

In addition, "In the Land of No Distributors"—

- **You would be pestered by an army of Manufacturers' salesmen.**
- **Deliveries would be chaotic. You would get partial deliveries and wait days for "slow" manufacturers.**
- **You would have to carry a tremendous inventory and insure it.**
- **You would go "telephone crazy" placing hundreds of calls a day to a variety of different suppliers located miles away.**
- **Your "Order Department" and "Accounts Payable" Department would have to be increased a hundred fold.**

That's why dependable electrical manufacturers advise you to always buy from

YOUR DISTRIBUTOR—THE BEST FRIEND YOUR BUSINESS CAN HAVE! He's the *one* source for *everything* electrical—and he's local.

It Must Be Right
The Trade Mark of TOP Quality
TRIANGLE ®

TRIANGLE CONDUIT & CABLE CO., INC.

New Brunswick, N. J.

Manufacturers of Arteries for Electricity, Liquids and Gases.

WIRE • CABLE • CONDUIT • PLASTIC PIPE • BRASS AND COPPER TUBE

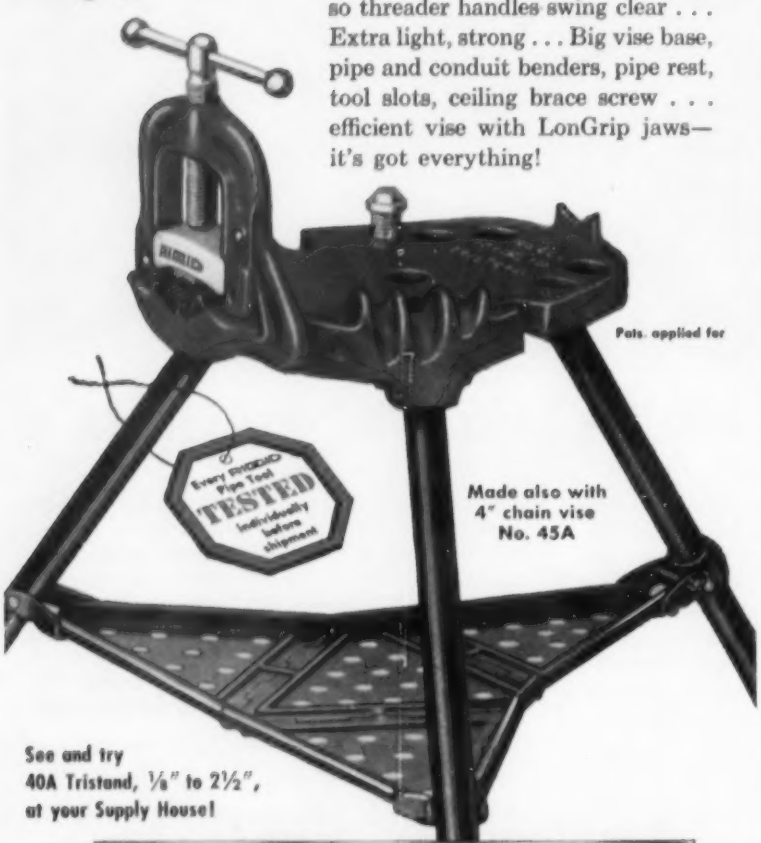
You've never seen a pipe vise handy as this 40A Tristand by RIDGID

with built-in folding tray...

all one unit, no loose parts, easy to set up or fold up for carrying . . . and tray makes it rigid as a stubborn mule!

Vise overhangs front legs

so threader handles swing clear . . . Extra light, strong . . . Big vise base, pipe and conduit benders, pipe rest, tool slots, ceiling brace screw . . . efficient vise with LonGrip jaws—it's got everything!



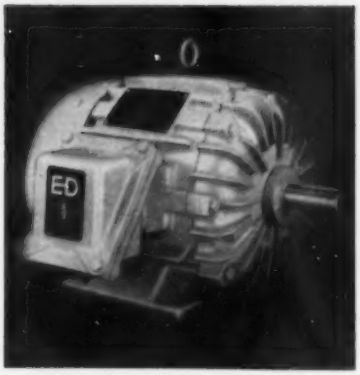
Pats. applied for

Made also with 4" chain vise No. 45A

See and try 40A Tristand, ⅛" to 2½", at your Supply House!

RIDGID Work-Saver Pipe Tools

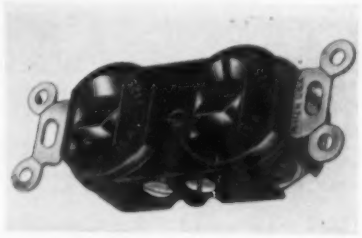
The Ridge Tool Company Elyria, Ohio, U.S.A.



Explosion-Proof Motors (15)

New rerated NEMA explosion-proof motor designated type "H" is manufactured in ratings 1-30 hp. Made for Class I Group D service for areas where inflammable gasses and volatile liquids are present. Class II Groups F and G service for areas where combustible dusts are present. Motor is fully enclosed, non-ventilated, in frames 182 and 184. Frames 213 through 326U are fully enclosed and equipped with sparkproof aluminum fan, cast iron conduit box. Motors are certified by UL.

Electro Dynamic Division of General Dynamics Corp., Bayonne, N. J.



Duplex Receptacle (16)

A new 3-wire, 2-wire combination duplex grounding receptacle which provides for two separate circuits with a common ground is available. Receptacle makes it possible to supply, from the same outlet, the current to operate a window air conditioning unit (or similar appliance), which requires 3-wire, 15-amp, 250-volt service for efficient operation, and any other appliance needing only conventional 2-wire, 15-amp, 125-volt service. The 125-volt section has slots which will accommodate only parallel blades. The 250-volt section has slots which will accommodate only tandem blades. Each section of duplex receptacle has a special U-shaped slot for the grounding blade. Device is available back or side-wired, in brown or ivorylite. Listed as standard by Underwriters' Laboratories. Catalog Sheet 26-G is available.

Arrow-Hart & Hegeman Electric Co., Hartford 6, Conn.

Announcing
ADVANCE
BALLAST SERVICING PLAN

This ADVANCE Fluorescent Lamp Ballast Servicing Plan has been established to save time and money for electrical contractors, lighting equipment manufacturers, engineers, electric utilities, architects and users of fluorescent lighting equipment. To serve you in this program ADVANCE, the world's largest exclusive ballast manufacturer, has appointed a nationwide network of service-stocking distributors. These authorized distributors carry a complete stock of ADVANCE ballasts and will replace, WITHOUT CHARGE, any ADVANCE ballast which becomes inoperative within the two-year warranty period. Also, from this ADVANCE stock, which includes ballasts to operate all fluorescent lamps, they offer immediate replacement service for any other make ballast.

The ADVANCE label is your assurance of dependable, efficient performance at lowest cost . . . the result of years of engineering and development that have made ADVANCE fluorescent lamp ballasts "The Heart of The Lighting Industry".

The new ADVANCE Buyer's Guide, the Cross-reference Fluorescent Lamp Ballast Replacement Chart together with the brochure listing authorized ADVANCE Service-Stocking Distributors will be sent to you without cost or obligation. Write today!

ADVANCE

CBM CERTIFIED

World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts

TRANSFORMER CO.

2950 No. Western Ave. Chicago 18, Illinois

"At the Northeastern Steel job—

We met a
taking our

LONG RUNS. Long runs of cable were made in a temporary location while the new building is being constructed in order to get steel-making equipment into operation quickly. Later, when the new plant is completed, the flexible and easily handled long runs of G-E VCI cable will be moved and permanently installed on racks on the side of the building. Coils of cable will provide extra length necessary for the permanent installation.

KENNETH PRIESTLEY, Vice President, The Eastern Electric Construction Company, found that the ease of installing General Electric varnished-cambric interlocked armor cable in long runs and in cramped places was a major factor in helping to meet a tight schedule on the Northeastern Steel job.

CORNERS AND BEAMS—usually a big layout and prefitting problem—caused no delay because General Electric's VCI cable was used. This flexible cable easily runs around corners or over beams and actually saved nearly 50% on layout and prefitting time.

SPLICING. Journeyman is shown splicing some G-E VCI cable on the site. Its simplicity is obvious. Terminations are simple too—high-voltage cables can be terminated indoors with a junction box—without potheads.

PROTECTION. The problem of adequate protection posed by the outdoor location of much of the cable, was solved with G-E VCI cable because it needs no additional protection, indoors or out.

tight production schedule by cable problems to General Electric"

"Some runs were as long as 825 feet on the big Northeastern Steel job," reports Kenneth Priestley, Vice President, The Eastern Electric Construction Company. "And lots of cables had to be run over and under obstructions in cramped places. Yet we completed the job well within our schedule. That's because we discussed our cable installation problems with the people at General Electric's Wire and Cable Department. With the assistance of one of their wire and cable specialists, we chose G-E varnished-cambric interlocked armor cable for these trouble spots."

To show you what Mr. Priestley means, some of the problems faced on this job are shown in the on-the-spot pictures on these pages.

Many products developed in General Electric's Wire and Cable Department are available to help you solve your problems: G-E Super Coronol* Geoprene* cable, for example, resists water, sunshine, and oxidation (and has an 85 C rating); G-E silicone rubber cable for installation where high ambient temperatures, high humidity, corrosive vapors, and other severe conditions exist; G-E preassembled aerial cable for outdoor runs, long spans, supported between poles, towers, or buildings.

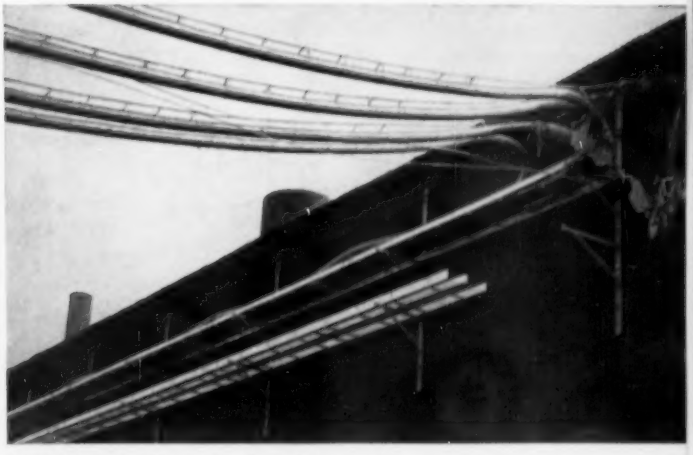
For specific information on General Electric wires and cables, get in touch with the wire and cable specialist at any G-E Construction Materials district office or with the Wire and Cable Department, Section W172-318, General Electric Company, Bridgeport 2, Connecticut.

*Registered Trade-Mark General Electric Company

Progress Is Our Most Important Product

GENERAL ELECTRIC

HANDLING. G-E V-C interlocked armor cable itself weighs only about ⅓ as much as conventional cable and conduit—is much easier and faster to handle. It can be pulled around corners with a simple pulley arrangement.



ADAPTABLE to all structural conditions, cables were supported by messengers in open areas and by racks and baskets in and around the buildings.

Black & Decker® Heavy-Duty Saws are POWER-BUILT to last longer on the job!

NEW 6½" Saw races through 2x4's... even at a 45° angle!

Black & Decker offers *the complete* HEAVY-DUTY saw line — with enough power and versatility for every professional need. This new B&D 6½" Heavy-Duty Saw (shown above) makes all cuts in 2x10's and smaller lumber, cuts 2x4's at a 45° angle with blade to spare.

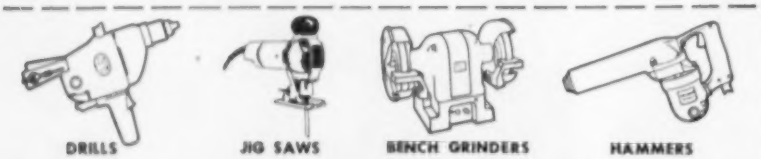
With proper blades, B&D Heavy-Duty Saws—6", 6½", 7", 8" and 9" models—will cut practically any material: ferrous and non-ferrous metals, corrugated sheets, ceramics, slate, tile, marble, transite! *Power-Built* with B&D motors, these rugged saws run cooler, offer latest safety features, more precise adjustments, extra convenience. Telescoping guard, larger lift-lever, instant-release trigger switch with guard . . . larger wing nuts for faster, more positive depth and bevel adjustments . . . clear-view operation . . . easier right or left hand cutting . . . all these features and many more assure faster, easier work, and much greater versatility!

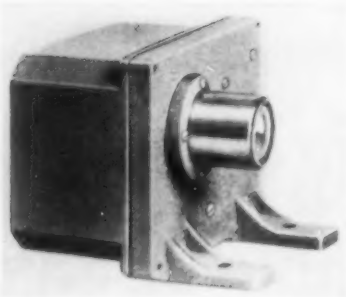
See your B&D distributor or write: THE BLACK & DECKER MFG. Co., Dept. 2303, Towson 4, Md.

SERVICE . . . one of 42 Black & Decker factory service branches is located "next door" to you. Staffed by experts to give fast, efficient service, genuine replacement parts.

LOOK IN THE YELLOW PAGES UNDER "TOOLS-ELECTRIC"

Black & Decker®
PORTABLE ELECTRIC TOOLS





Relays (17)

A new control unit combining a photoelectric relay and a timing relay, both triggered by the same photoelectric element. Relay energizes when light beam is interrupted. Timing relay energizes when timing period elapses while light beam is interrupted. Photoelectric relay contacts are SPDT, rated 4 amps at 115 volts ac non-inductive load. Timing relay contacts are DPDT, rated 8 amps at 115 volts, ac, non-inductive load. Time delay is adjustable over a wide range. Combined controls are mounted in a splashproof, cast aluminum case tapped for ½ in. conduit. Lens diameter 1¼ in. Furnished for 115/230 volts, 50-60 cycle. Overall dimensions; width, 7¼ in; height 5¼ in; depth 6½ in. Literature is available.

Autotrom Company, Box 722-DD, Danville, Ill.

Lighting Standard (18)

New lighting standard for fluorescent luminaire, known as "Elite". Standard is designed especially to accommodate the new slip-fitter type of fluorescent unit. Mounted at a five-degree angle, the luminaire extends 24 in. onto a 2-in. pipe extension of the 5-ft davit-type mast arm. The simplified design utilizes high-strength steel throughout, and is available in all popular mounting heights.

Millerbernd Manufacturing Co., Winsted, Minn.

Cutler-Hammer Service Control
Tops in economy without compromise

Smart contractors everywhere are saying, "I never compromise when I install service control—I use Cutler-Hammer, it's tops at no extra cost . . . exactly the right type of unit for each job, never a makeshift substitute".

Standardize on C-H service control and you insure uniformity of installation, uniformity of performance, and uniformity of customer satisfaction. Every member of the Cutler-Hammer Service Control family is manufactured to meet the same standards of quality motor control. A host of plus features make C-H service control easiest to install, tops in performance and long life.

Cutler-Hammer's complete line of service control rules out compromise. There is the "perfect" type of service control available for each job . . . you install just what your job requires, nothing more, nothing less.

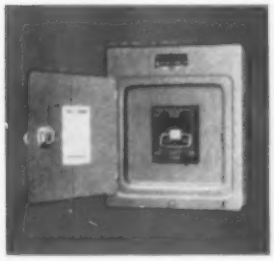
Your Authorized Cutler-Hammer Distributor carries a complete stock of this service control, you never need "shop" for the "perfect" type of a unit. A single source of supply . . . a reliable source of supply.

Let Cutler-Hammer Service Control help sell your service. Cutler-Hammer, nationally advertised in such magazines as *SATURDAY EVENING POST, TIME, NEWSWEEK,* etc. is recognized by all as a manufacturer of quality products. Don't build "sales resistance" by using an unknown brand . . . standardize on CUTLER-HAMMER, a name respected by your customers.

C-H service control is tops in economy . . . priced with the lowest—quicker and easier to install, you spend less time on the job—works better and lasts longer, you make fewer service calls.

Standardize on Cutler-Hammer Service Control—either fused or breaker type. For further information see your Authorized Cutler-Hammer Distributor today. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

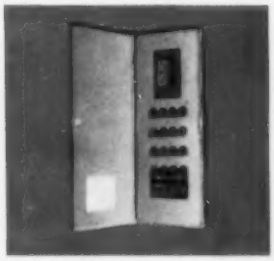
CUTLER-HAMMER
SERVICE CONTROL
C-H



4330 Line—One 60 Ampere pull-out. Up to 8 plug fuse circuits. Surface and flush mounting. NEMA 1 and NEMA 3 enclosures.

4334 Line—Two 60 Ampere pull-outs. Up to 8 plug fuse circuits. Series or parallel connected. Surface or flush mounted. NEMA 1 and NEMA 3 enclosures.

4335 Line—Three 60 Ampere pull-outs. Up to 8 plug fuse circuits. 60 Ampere water heater pull-out easily wired for separate metering. Surface or flush mounted.



4336 Line—100 Ampere main pull-out with two 30 or 60 Ampere branch pull-outs. Up to 16 plug fuse circuits. Surface or flush mounted. NEMA 1 and NEMA 3 enclosures.

How to turn a warehouse into a modern office

with the help of
Electro Silv-A-King Lighting

"Magic Frame Troffers easiest to install fixture we've ever handled."

—M. J. Rihel, Supt. Hultgren Elec. Co., Chicago

Three floors of this Butler Bros. Building in Chicago, each averaging 56,000 sq. ft., were completely remodeled into the modern, air-conditioned offices shown above in exactly four months from the first planning meeting. According to Butler Bros. Engineering Dept., and the contractor Hultgren Elec. Co., Chicago, Electro Silv-A-King's Magic Frame Troffers —with their one piece removable Reflector Plate Wireway cover containing all electrical components were installed with record speed.

Throughout the entire three floors, these fixtures provide a maintained lighting level of 50 F.C. free of glare and shadow. Comments concerning these better, modern troffers have been extremely favorable from the tenants and office personnel.

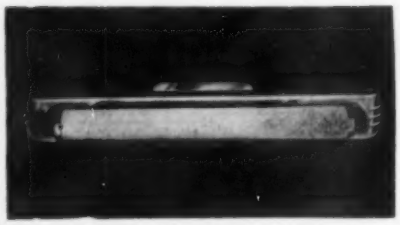
Complete "Magic Frame" Data and Specification Catalog available

Electro Silv-A-King Corporation

1535 South Paulina Street, Chicago 8, Illinois

Spruce & Water Sts., Reading, Pennsylvania

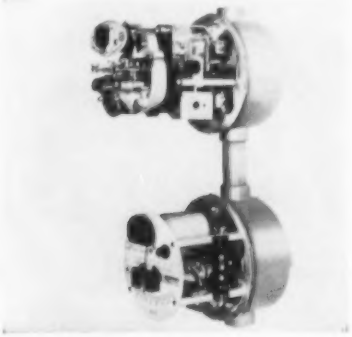
DESIGNERS AND MANUFACTURERS OF THE FINEST IN LIGHTING



Fluorescent Bracket (19)

New one piece, deep drawn fluorescent chrome brackets featuring instant start in the 15- and 20-watt size. The 4100 Series brackets are designed for either vertical or horizontal installations. Each bracket is equipped with swivel hangers and features the "E-Z-OFF" method that tilts to any position with finger tip adjustment and is quickly removed for relamping or cleaning. Triple chrome plated fixtures contains a built-in outlet box cover.

Markstone Manufacturing Co., 2460 *W. George St., Chicago* 18, *Ill.*

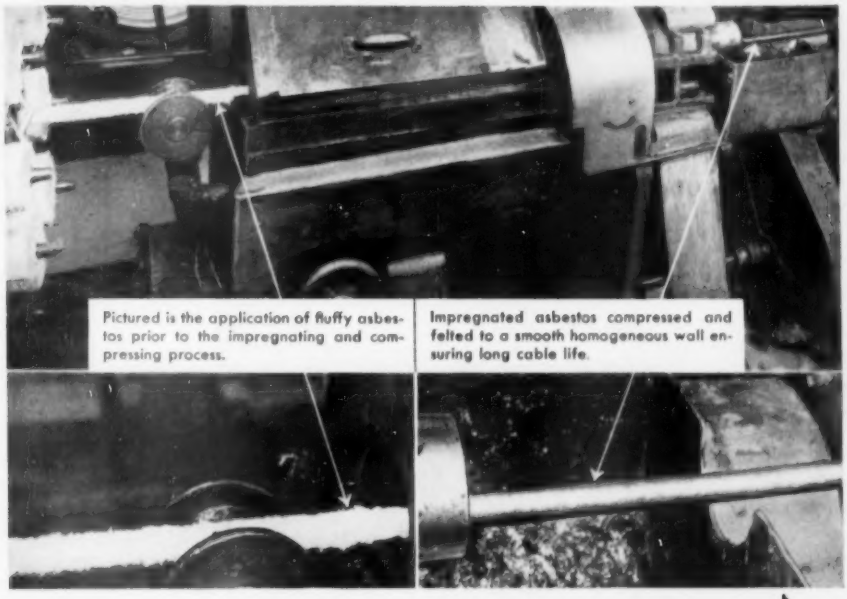


Controls (20)

Socket-mounted current controls with either a high or low voltage override, are designed to actuate oil switches for capacitor banks. When voltage is within a predetermined limit, (adjusted for high or low on the voltage control) capacitor switching is accomplished by the current control. If the voltage exceeds the predetermined limit, the voltage control will switch the capacitors to correct the condition. Control can be adjusted for a minimum difference of ½-amp between On and Off settings anywhere on the 5-amp scale. It has a thermal element for time delay and a fuse protecting control and load circuits. Voltage control has a 1½- to 12-volt adjustable band width, 110- to 130-volt operating range, a time delay of about 60 seconds, fuses for both load and control circuits, and a lightning arrester. Both controls have 20-amp load contacts, and operate on 120-volt, 60-cycle source for control and load. Each is mounted in a standard 6-prong meter base with their sockets connected and wired.

Line Material Co., 700 *W. Michigan St., Milwaukee* 1, *Wis.*

seamless FELTED ASBESTOS walls add up to long range economical service



Pictured is the application of fluffy asbestos prior to the impregnating and compressing process.

Impregnated asbestos compressed and felted to a smooth homogeneous wall ensuring long cable life.

look beneath the braid

. . . that's where quality begins

Long lasting, trouble-free circuit performance depends on the materials and construction of wire and cables. And a look under the braid shows why Rockbestos A.V.C. (N.E.C. Type AVA) is built to give longer service.

The two seamless, dense felted asbestos walls, compressed and thoroughly impregnated with selected compounds, seal the varnished cambric from heat and moisture.

Dielectric strength stays high under high ambient temperatures. Heat dissipation is uniform. The felted wall construction protects the varnished cambric from rupture in the sharpest bends.

HERE'S HOW YOU BENEFIT*

Get high dielectric values from Varnished Cambric because of its controlled application over seamless felted asbestos walls.

HIGH DIELECTRIC STRENGTH — minimum breakdown voltages for 600 and 1000 volt power cables — 15 KV.

MOISTURE RESISTANCE — same minimum dielectric breakdown — wet or dry — 15 KV on 600 and 1000 volt power cables.

RUGGED CONSTRUCTION — minimum breakdowns after bending tests — 15 KV for 600 and 1000 volt power cables all sizes.

CONTROLLED QUALITY — materials and workmanship and performance under rigid Quality Control.

CUTS MAINTENANCE COSTS — It won't bake brittle, crack or flow in high ambients . . . won't deteriorate with age, or rot when exposed to oil, grease or fumes.

The result: wire failures are eliminated; maintenance costs are held down; plant and equipment operation maintained at top level.

*Write for the test and construction specifications of Rockbestos A.V.C. (N.E.C. Type AVA) available in the new booklet, "Specification RSS-88."

STOCKED COAST TO COAST
Standard Rockbestos A.V.C. construction (N.E.C. types AVA, AVB, etc.) are available for immediate shipment. Call or write nearest branch office.

ROCKBESTOS PRODUCTS CORP.
NEW HAVEN 4, CONNECTICUT

NEW YORK CLEVELAND • DETROIT • CHICAGO • PITTSBURGH • ST. LOUIS • LOS ANGELES • NEW ORLEANS
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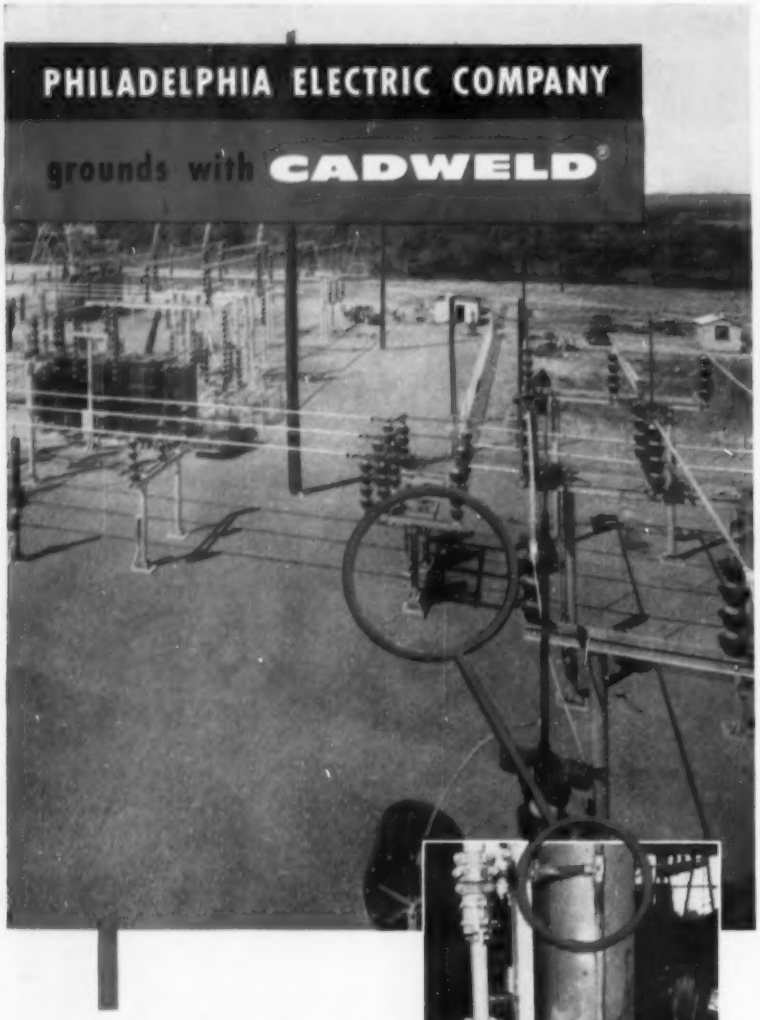
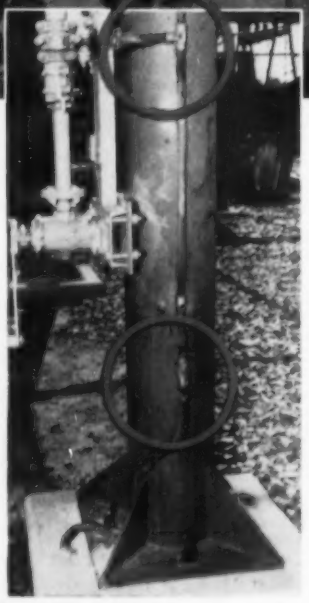


Adequate grounding on a utility power system is of paramount importance for the protection of personnel and equipment. A complete line of connections has been developed with the co-operation of Erico Products, Inc., that makes it possible for us to use Cadweld connections on all of our heavy capacity ground circuits.

PHILADELPHIA
ELECTRIC COMPANY



CADWELD®

Erico Products, Inc.

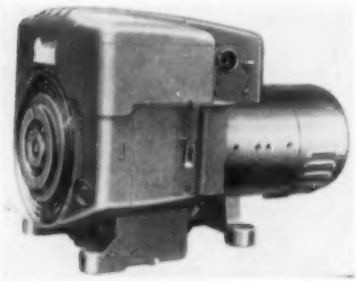
2070 E. 61st Place · Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

Floodlight (21)

New WS-8 Aqualux floodlight is designed and constructed for long life and minimum maintenance in "wet niche" underwater lighting systems for swimming pools. Pools up to 50 ft wide can be lighted with a single row of new units. Design features include extensive use of noncorrosive bronze, a single neoprene water seal, and provisions for servicing the unit without draining the pool. After removing the assembled body, lens, and lens holder from a fixed mounting frame, unit may be moved to rim of pool. 15 ft of Type S cable stored in the mounting recess permit flexibility without need for disconnecting. Completely waterproof, unit may be used with 250-, 300-, or 500-watt lamps. Standard clear glass lenses are available in three types: plain, stippled, and rectilinear spread. Overall, each unit measures 12 in. high, 12 in. wide, and 8¾ in. deep.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.



Generating Plants (22)

Two new electric generating plants in 3500 and 5000-watt ac sizes. Models 305CCK and 5CCK are powered by a 2-cylinder gasoline engine. Remote starting model, 305CCK, is 26¾ in. long; width 21⅛ in., and height 20¾ in. Both models are available in 60- or 50-cycle; 115-, 230- or 115/230-volt, single phase, and 230-volt, 3-phase, 3-wire. There is a choice of standard remote control, portable or manual starting models. Generators are directly connected to the engines for permanent alignment.

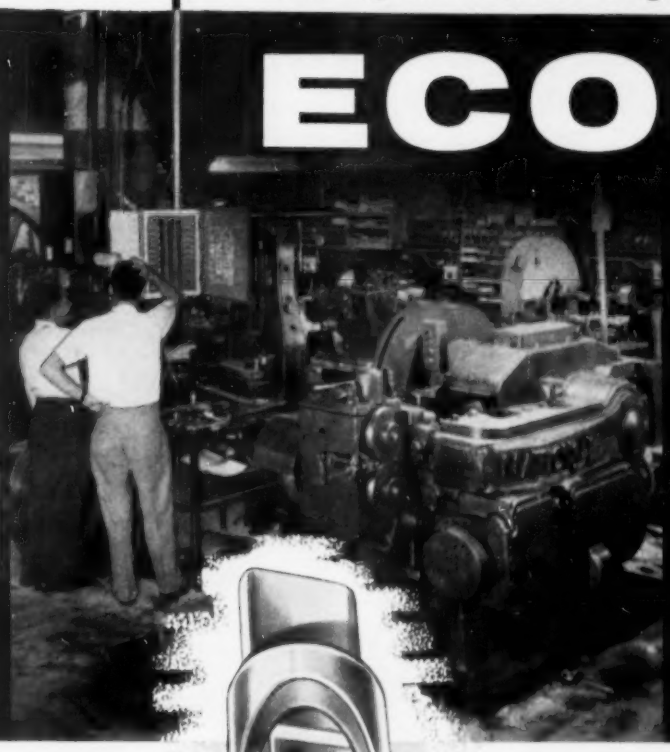
D. W. Onan & Sons, Inc., Minneapolis, Minn.

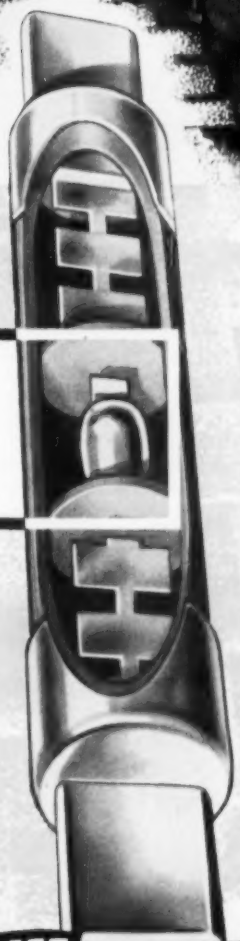
...and no other fuses protect exactly the same way as

ECON®

dual-element cartridge fuses

NOTHING ELSE gives the same PROTECTION AS A FUSE





Only Econ Fuses have the Econ-Alloy thermo element which has the property of changing from a solid to a liquid, without going through a plastic state. This makes possible Econ's faster and more accurate protection against harmless overloads and short circuits.

Available at leading electrical wholesalers in knife and ferrule types: 0 to 600 Amp., 250 to 600 V. Underwriters' Laboratories approved. Write us for new ECON Catalog S-60 or for Complete Line Fuse Folder.

See Your Electrical Wholesaler for ECON and other Fuses

NO MATTER what other devices are used to guard your motors or branch circuits, they do not take the place of fuses. Furthermore, in order to get the fullest, surest, best protection, it is advisable to use **ECON** Dual-Element Fuses. Because they have the exclusive Econ-Alloy thermo-element that insures the Double Protection which reduces down-time and its consequent loss to men and management!

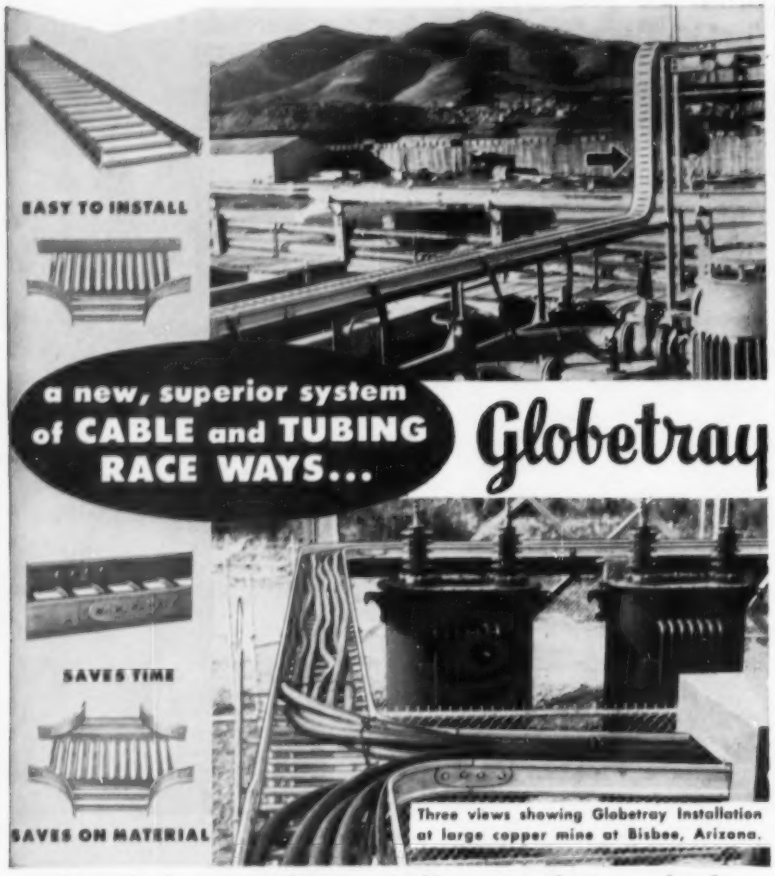
1 ECONS give time-controlled protection against unnecessary blowouts from temporary and harmless overloads . . . a frequent cause of shut-downs.

2 ECONS give instantaneous protection against short circuits . . . operate at low temperature . . . prevent overheated circuits.

ECONOMY fuses for every purpose

ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago 14, Ill.

1306R



A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point – insides and bottom always smooth – all sections punched for easy installation – perfect fit at all times. Neat, clean and uniform in appearance.

Write for new complete catalog. Distributors in all principal cities. Contact the Grip-Strut distributor under "Conduits" in the classifed telephone directory.

Manufacturers Since 1914 **The GLOBE Company**

4032 S. PRINCETON AVE. • CHICAGO 9, ILL.

Automatic Clutch **(23)**

A new automatic clutch designed for 1/6, ¼ and 1/3 hp electric motors, designated the Mercury 305. They are recommended for original equipment on air conditioners, furnace blowers, automatic washers, sweepers, dryers, power tools, vacuum pumps and other fhp powered equipment. The clutch reduces the length of sustained inrush current by permitting the motor to reach full speed before any load is applied. Literature is available.

Mercury Clutch Division, Automatic Steel Products, Inc., Canton, Ohio.

Paging System **(24)**

Private, individual paging of institutional personnel and key administrators is now possible with a new pocket radio paging system, called Handie-Talkie. No one except the pagee is aware that a message is being transmitted. System consists of a selector console with individual buttons for key personnel, and FM transmitter that radiates alerting tones and voice messages within a confined induction loop area, and the individual, all transistorized Handie-Talkie radio receivers themselves. Portable receiver itself, using transistors throughout, weighs 10 ounces and measures slightly larger than a pack of king size cigarettes. Unit can be clipped in a pocket or worn on a belt by the pagee. Powered by a 4-volt mercury cell battery, its FM reception is immune to common types of interference generated by X-Ray, diathermy and other noise-generating equipment.

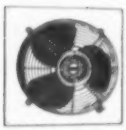
Motorola Communications and Electronics, Inc., 4545 W. Augusta Blvd., Chicago, Ill.

FREE! Your new guide to better plant ventilating!

1956 Westinghouse Fans for plant ventilating...

Whirlaires®

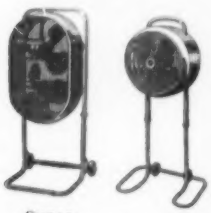
Rivieras®—for floor or wall use



Economy Exhausts

Desk-bracket Oscillators

Debonaire®



Super Mobilaire Mobilaire®

All the facts on today's top line of fans!

Exhaust fans, ventilating units, man-coolers . . . the 1956 Westinghouse line includes fans job-engineered to handle problem ventilating assignments in your plant.

And this new Westinghouse Fan and Ventilator Catalog includes photographs, performance ratings, and specifications on the entire line of 1956 Westinghouse fans *plus* the inside story on the exclusive, patented Westinghouse Air-Injector Rings—that give *40% greater fan capacity*—and the Air-Jet Vanes—that give *50% greater air penetration.*

Mail coupon today!

All Westinghouse Fans are guaranteed 5 years.

YOU CAN BE SURE...IF IT'S
Westinghouse

Westinghouse Electric Corp.
Electric Appliance Division, EC-356
246 E. 4th St., Mansfield, Ohio

Gentlemen:

Please rush my free copy of the new 1956 Westinghouse Fan and Ventilator Catalog.

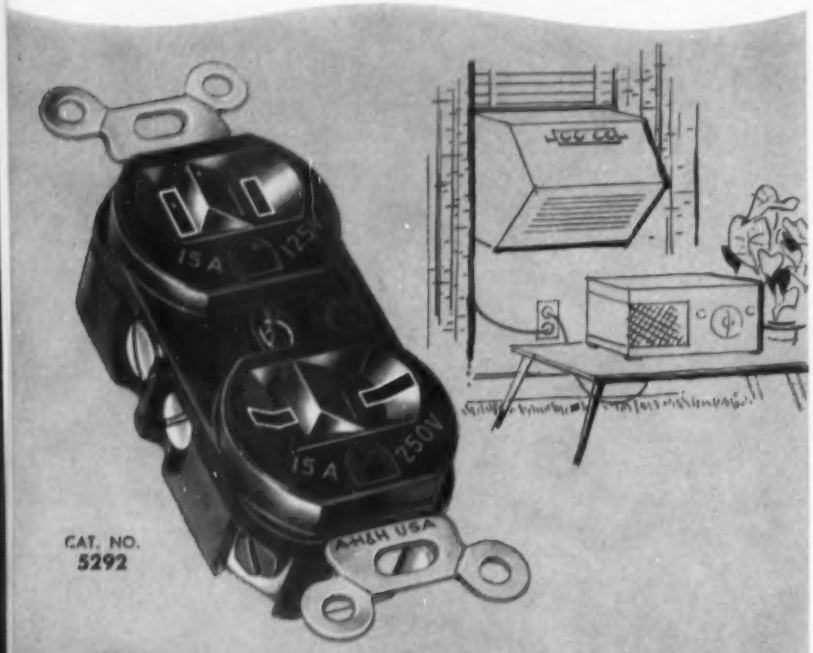
Name_____

Company_____

Address_____

City_____ Zone____ State_____

Simplifies your
air conditioning installations



LISTED AS STANDARD BY UNDERWRITERS' LABORATORIES

New

ARROW AH HART

COMBINATION
Duplex Grounding
RECEPTACLE

for BOTH 15 AMP 125 VOLT AND
15 AMP 250 VOLT SERVICE

Tie two circuits into one receptacle, one wall box. Install the ONE receptacle that will supply 15 amp – *250 volt* service for air conditioning units as well as 15 amp – *125 volt* power. Polarized slots make it impossible to plug an appliance into the wrong circuit.

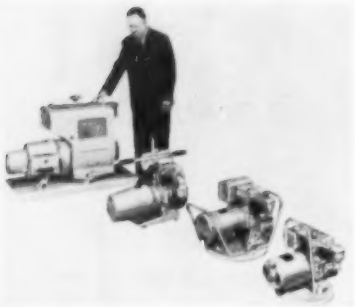
Only Arrow-Hart makes it. Only Arrow-Hart distributors sell this new Combination Duplex Receptacle that will make your new or re-wiring installations easier . . . faster . . . more economical!

Write for Catalog Page 26-G.

ARROW AH HART

Wiring Device Division
THE ARROW-HART & HEGEMAN ELECTRIC CO.
103 Hawthorn Street, Hartford 6, Connecticut
Offices, Sales Engineers and Warehouses in Principal Cities

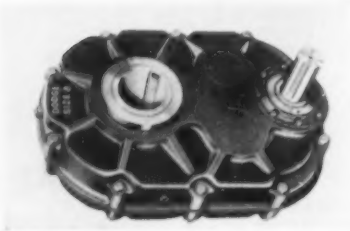
Quality WIRING DEVICES • MOTOR CONTROLS • ENCLOSED SWITCHES • APPLIANCE SWITCHES



Generators (25)

A new line of portable gasoline engine-driven generators. Eight new ac and dc models in 750 watts, 1500 watts, 3 kw and 5 kw capacities, make it possible to provide the right amount of power for any purpose: emergency stand-by power, central power supply, portable power, power for construction equipment, and supplementary power for public utilities and institutions, etc. All models have direct-connected engine and generator, automatic pilot light, inherent voltage regulation, are shock mounted for minimum vibration, and equipped with air-cooled engines and automatic governors. 750- and 1,000-watt models are powered by Briggs and Stratton engines; 3 and 5 kw models by Wisconsin engines. The 5 kw unit is mounted on a portable skid base for towing and lifting; other models have handles for easy carrying.

Master Vibrator Co., 264 Stanley Ave., Dayton 1, Ohio.

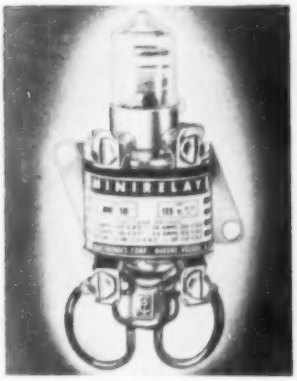


Speed Reducers (26)

With the recent addition of two models to its torque-arm line, shaft-mounted speed reducers, with capacities from 1 to 60 hp and output speeds from 12 to 365 rpm are offered. The new size No. 8, in the double reduction series, extends all the advantages of shaft mounting. The No. 8 has a capacity of 60 hp at 100 rpm, AGMA rating, and can be mounted on shafts up to five inches diameter. At the other end of the torque-arm line is the new No. 11, with a capacity of 1.3 hp at 100 rpm. The reducers are mounted directly on the shaft, and the torque-arm is fastened to any fixed object, anchoring the reducer. The unit is driven through a V-belt drive. Taper-Lock sheaves permit any speed ratio desired. The Tri-Matic

overload release which loosens the belts, cuts off power and gives a warning in case of excessive load is available for use with any torque-arm reducer. A built-in backstop may also be provided when conditions require a device to prevent the reversal of the direction of rotation. Bulletin A-637 is available.

Dodge Manufacturing Corp., Mishawaka, Ind.



Relay **(27)**

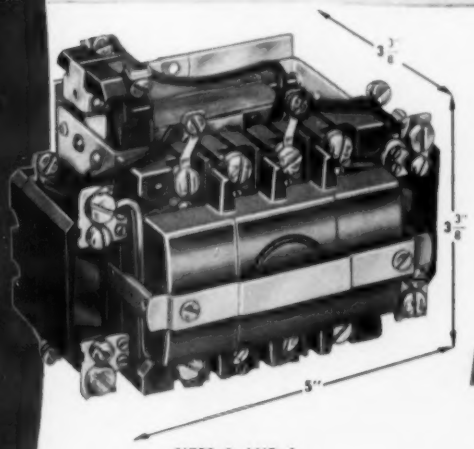
A new mercury plunger relay, known as the midget Minirelay. It is capable of handling any load up to 20 amps or 1.5 hp at 115 volts, 50/60 cycles. It has an action of approximately 30 milliseconds to make or break. Measuring 3½ in. tall by 1¾ in. wide by 1½ in. deep, it has been designed for compact multiple arrangements and for ease of installation. Mercury-to-mercury contacts are totally enclosed in hermetically sealed heavy industrial glass for safe, silent operation even in explosive, dusty, dirty or moist atmospheres where open-type mechanical relays are inadvisable. Minirelay is available with either normally open or normally closed contact, SPST. Coils are obtainable at any operating voltage required.

Ebert Electronics Corp., 212 Jamaica Ave., Queens Village 7, N. Y.

Transformer **(28)**

A new 15,000-volt butyl-molded indoor current transformer, the JKM-5, is designed for metering and relaying applications and supersedes the older type JKR-5 single-secondary design.

Now IMPORTANT IMPROVEMENTS



SIZES 0 AND 1

IN THE MODEL 55

ARROW AH HART

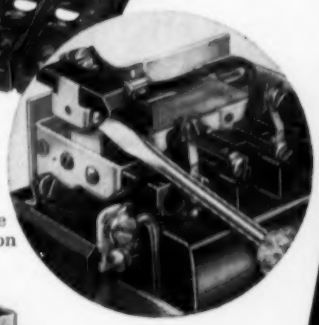
MAGNETIC STARTERS and CONTACTORS

THE SAME SPACE-SAVING "RA" DESIGN

plus these all-new features —

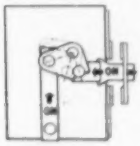
• **NEW CONTACT DESIGN** . . . and a special new alloy for longer life, greater resistance to welding. New, metal contact carrier post.

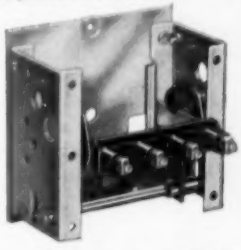
• **NEW RESINOX HOOD and BASE** . . . for maximum tensile strength and added dielectric strength.



• **NEW AUXILIARY SWITCH** . . . improved, sturdy mechanism. Front mounting for easier removal.

• **NEW, SIMPLIFIED "RA" MECHANISM** . . . same compactness plus more efficient operation in industrial atmospheres where dust and metal filings are prevalent.





Write today for complete information

ARROW AH HART

Motor Control Division

THE ARROW-HART & HEGEMAN ELECTRIC CO.

103 Hawthorn Street, Hartford 6, Connecticut

Offices, Sales Engineers and Warehouses in Principal Cities

Quality MOTOR CONTROLS • WIRING DEVICES • ENCLOSED SWITCHES • APPLIANCE SWITCHES

Know what it costs to send him up a ladder?

Fifty cents a round trip—maybe more. But half his effort may be unnecessary! It's this simple: If you are using series-type ballasts in your lighting fixtures and a lamp burns out, the other lamp burns dimly or goes out completely. The maintenance man has no way of knowing which lamp is defective unless he takes the time to test both. NOT so with Westinghouse slimline *lead-lag* ballasts—when one lamp burns out, the other lamp is not affected. Thus, valuable maintenance time is saved without the possibility of wasting good lamps or losing light. In addition, Westinghouse slimline *lead-lag* ballasts have a new UI core design to give you a cooler, quieter, more efficient operation.

Planning a new lighting system? Specify Westinghouse slimline *lead-lag* ballasts for real lamp replacement economy.

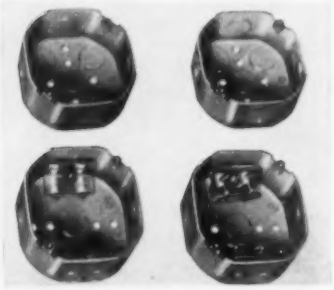
More information? See your Westinghouse representative or write Westinghouse Electric Corporation, Lighting Division, Edgewater Park, Cleveland, Ohio. J-04394

YOU CAN BE SURE...IF IT'S

Westinghouse

The JKM-5 meets the 110 kv impulse level, and for most ratings will stand continuous operation at 150% of rated current. Available in all standard, single-primary current ratings from 10 to 800 amps, the JKM-5 supplants transformers in two 15 kv insulation classes: the 15L and the 15H with full wave impulse levels of 95 kv and 110 kv respectively.

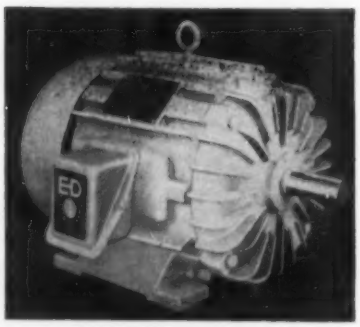
General Electric's Instrument Department, West Lynn, Mass.



Outlet Box (29)

Pri-outs and "smooth ridge" clamps have been incorporated into the design of a new 4-in. octagon outlet box. The box, made of heavy code gauge steel, is the standard drawn box 1½-in. deep. BX clamps are furnished for installation of armored cable and flexible non-metallic tubing. Romex clamps for non-metallic sheathed cable or non-metallic flexible tubing. Knockouts are ½ in. and ¾ in. for rigid metallic conduit, and the 21/32 in. pri-outs are located for side or bottom entry. In addition, ½ in. knockout boxes and boxes with either BX or Romex clamps are available in combination with shallow and deep offset bar hangers 19½ in. and 24 in. long. Catalog is available.

Keystone Manufacturing Co., 23328 *Sherwood Road, Center Line, Mich.*



Fan Cooled Motor (30)

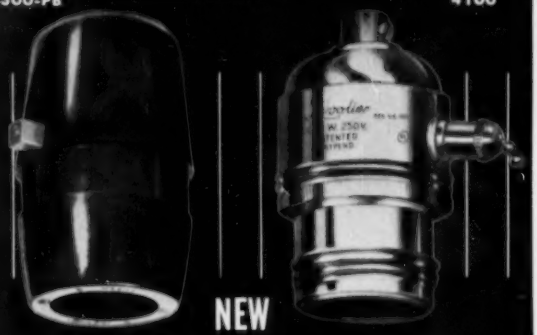
An improved rerated totally enclosed non-ventilated and totally enclosed fan cooled motor conforming to the dimensional standards recently adopted by NEMA. Motors have been designed more compactly than previous NEMA design, utilizing less space

Model 41 unconditionally Guaranteed

eliminate switch failures with THE SWITCH THAT'S always READY

Pampered in production to withstand abuse in use, the Levolier® #41 switch retains its positive action even after hundreds of thousands of pulls. It is unconditionally guaranteed against failure in lighting circuits. Its one-piece molded phenolic case insures better insulation, makes wiring easier. Removal of the mounting nuts lets the mechanism slip out, exposing terminals. A 6 amp "T" 125 volt switch, it is only 5/8" x 1 3/8" x 1 3/8". Ideal for individual control of lighting fixtures.

4300-PB 4100

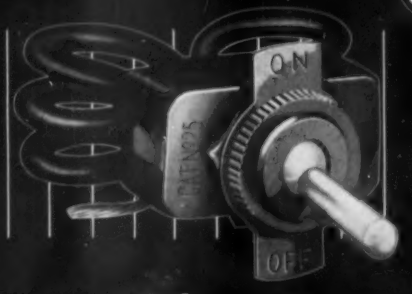


NEW Industrial LAMPHOLDERS with Levolier® Switch Dependability

Whether you prefer universal lever or the new push button control, you can have a Levolier Lampholder that has a proven record of long service in strenuous industrial use. Levolier switch mechanisms are built into both brass and molded phenolic heavy duty lampholders in a variety of single or two circuit models. All are built to eliminate failures in plant and machine lighting that can mean costly production time losses.

only McGILL makes Levolier® Switches

Levolier® No. 25



Specify Levolier for Dependability in Toggle Switches

The Levolier® No. 25 Toggle Switch is "T" rated for 6 amps — 125 volts and especially dependable for FHP motors on quality appliances, portable tools and for panel boards. Only 1/2" thick, 1/2" wide and 1" long. The molded phenolic case is dust and vibration proof. 6" wire leads with choice of colored levers for easy identification of circuits. Available also in three way and two circuit models with lugs or screw terminals.

For FASTER, EASIER WIRING specify Levolier® No. 71 switches

A single pole, single circuit switch, the Levolier® No. 71 model is the thinnest 6 amp "T" 125 volt switch on the market today. Only 15/32" thick, it insures quicker and easier installation because of the 6" wire leads that are permanently fastened to the terminals by pressure connections. Standard finishes: brass, dark bronze and burnished nickel, with brown molded phenolic case. The No. 71, like all Levolier switches, is Underwriters' approved.

McGILL®

ELECTRICAL SPECIALTIES

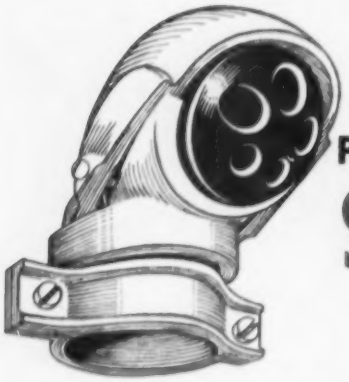
are always a little better and **ALL** *are Underwriters' Laboratories Inspected*

Available through leading Electrical Wholesalers

For complete information on McGill Electrical Products, write today for the new Catalog No. 84.

McGILL MANUFACTURING COMPANY, 450 N. Lafayette Street, Valparaiso, Indiana

Installation is FASTER·EASIER

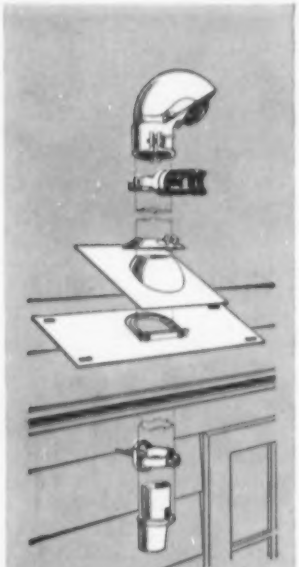


with

Porcelain Products

SERVICE MAST KITS

New 1 Piece
Clamp-On Entrance Cap—Eliminates *All* Pipe Threading



Cut installation time and costs *Even More* . . . with Porcelain Products Service Mast Kits that *now* feature the new Clamp-On Entrance Cap. This new cap, with the standard slip-fitting offset reducer, completely eliminates any threading of the 2" pipe. *Complete in every detail* . . . roof flashing—even necessary bolts, nuts, lag screws and nails are included in every kit. *Can be installed by an electrician with electrician's tools.*

CHECK THIS LIST OF COMPLETE PARTS

- √ 1¼" Size Clamp-On Service Cap of Aluminum that fits a 2" pipe
- √ Hot Galvanized Roof Flashing and Storm Collar
- √ Hot Galvanized Roof Mounting Plate of exclusive design
- √ Conduit hanger with 2¼" lag screw attached
- √ Slip-fitting offset reducer of Aluminum with concealed grounding wedge
- √ Non-hardening roof sealing compound
- √ All necessary bolts, nuts, lag screws and nails
- √ Plus—Porcelain Products famous 2061-C Pipe Mounting house brackets as specified

WRITE FOR DETAILS TODAY!

ELECTRICAL PORCELAIN SINCE 1894

62 years

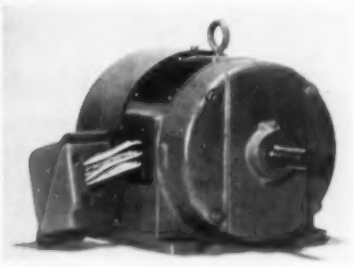
Porcelain Products, Inc.

PP INC.

FINDLAY, OHIO

and larger hp output. Complete housing and end-brackets are constructed of cast iron, ribbed frame. The new motor designated at type "H" is designed for operation where noncombustible dust and moisture are prevalent. Motors are now in production on the 182, 184, 213, 215, 254U and 256U frames. Larger ratings will be available in the rerated frame sizes later.

Electro Dynamic Division of General Dynamics Corp., Bayonne, N. J.



Motors (31)

Two new ac lines of enclosed, nonventilated, fan-cooled motors, designated as "Standard Enclosed" and "Severe Duty Enclosed". They will replace a single line of one-through-five hp motors. "Standard Enclosed" motor features a steel conduit box and fan cover. Conduit box has "keyhole" mounting. Mounting screws need not be removed. A ¾-in. conduit hole with a ¾-in. knockout is provided. Conduit box is gasketed with cork neoprene. Fan cover is of steel. Both lines feature longer perma-numbered leads for use with time-saving wire nuts. The "Severe Duty" line is basically the same as the standard line, except for certain features which make the severe duty motor suitable for use in corrosive or excessively moist atmospheres.

General Electric Co., Schenectady 5, N. Y.

Power Outlet (32)

A new surface-type power outlet, shallow and compact in design, measuring 1.296-in. from mounting plate. It is designed to fit a minimum size single-gang box without touching the box sides, and the shallowness of unit allows ample space at bottom of box for lead-in wires. As a safety feature, the heads of the terminal screws are held captive to the terminal plate. Pressure terminals are cadmium plated to resist corrosion and permit use of aluminum building wire. Units fit any standard single-switch box and will go into the NEMA minimum size box without touching or scraping the sides. Three holes in the mounting plate provide mounting flexibility. Center hole may be used for mounting

THE METER MOUNTING that has made Socket Metering Practical

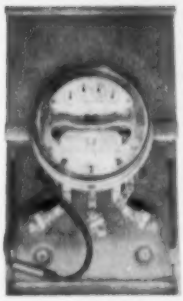
NOW — No interruption of customers service when testing or replacing meter — eliminates possible damage or annoyance

C200-SE
Closed view.

EXTRA HEAVY DUTY 200 AMP. +

1. **Costs Less** . . . as installation can be made in about one half the time—ample wiring room.
2. **Continuous Service** . . . even while meter is being removed or tested.
3. **Safe** . . . no wires behind the meter to cause shorts or grounds.
4. **Construction** . . . eliminates any chance for water or condensation getting behind meter. Extra knockouts for adding other services, ground conduits, or time clocks.

List Price—$24.70 Painted gray galvannealed steel + plated copper parts.
Also available in 150 ampere, C150-SE—List price $18.25 same cabinet and terminals as C200-SE.



C200-SE
Showing two methods of by-pass. Link jumper on right side, lead-type jumper on left side.

EXTRA HEAVY DUTY C200-SE

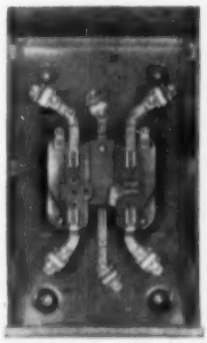
All busbars are copper (plated). Busbar size ¼" x ¼" Cabinets are galvannealed steel or 12 gauge aluminum (.081).

Terminals take up to 4/o wire. Terminals are reinforced to carry 200 amp.+

Air space (1¼") behind terminal block to carry off heat and keep moisture away from meter.

By-pass will carry full load when testing feed and distribution centers.

Cabinet . . . 17 x 10 x 4 block . . . time tested porcelain Neutral . . . terminals on top and/or bottom of cabinet. Wire can enter from any angle. Design insures absolute weather protection.

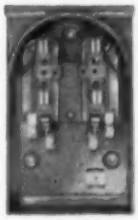


CODE SOCKET METER MOUNTINGS

Meter can be removed, tested, or additional mountings may be added with no interruption of customers service.

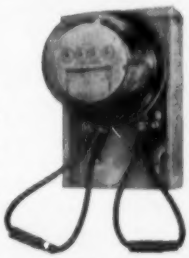
C-100-G2

By-pass for removal or testing without disrupting customer service. Threaded terminals to attach jumpers on all Code meter mountings.



C100-S

For temporary disconnecting or testing, load side can be disconnected without removing meter.



C100-TO

We manufacture a complete line of indoor meter connection boxes, "A" type mountings, Polyphase meter cabinets, as well as many types of special meter mountings and meter connection blocks.

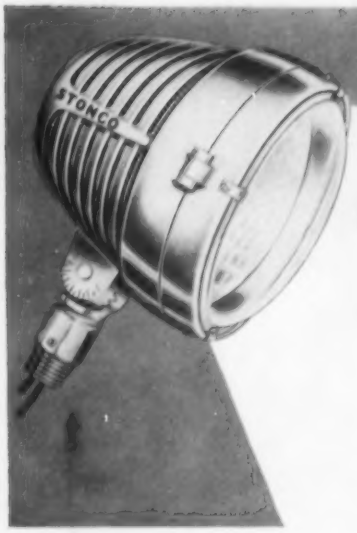
All meter mountings manufactured under Morgan J. Lewis Patents-Numbers 2,548,510, 2,582,638, 2,592,299, 2,691,693 and other Patents and Patent Applications.

WE INVITE YOUR INQUIRIES FOR—Further information, Literature, or Samples

TRADE MARK
CODE
ELECTRIC SWITCHES AND EQUIPMENT

THE CODE PRODUCTS CORPORATION

4566 BAKER STREET, PHILADELPHIA 27, PA.



NEW STONCO

NO. 64 FLOOD:

121,000 cp

for only

500 watt rating

- **Double the Lamp Life**
- **Faster Heat Dissipation**
- **Rain-tight**
- **High Intensity**

LONG THROW NARROW BEAM—
Especially effective for long range floodlighting of railroad and freight yards, piers, docks, golf driving ranges – or where floods must be mounted at a considerable distance from the area to be illuminated . . .

WIDE AREA COVERAGE—
Available with wide beam for brilliant, economical floodlighting of large, wide areas such as baseball and football fields, racetracks and industrial areas . . .

Here is a powerful, new outdoor floodlight that concentrates its light in a long-throw, oval-shaped beam that produces over 121,000 candlepower with only a 500 watt rating – almost twice the maximum beam candlepower of general service lamps in the most efficient reflectors. And the lamp life is rated at 2,000 hours – double the normal life of standard lamps in average use.

Stonco No. 64 is precision cast aluminum throughout, and carefully engineered with heavy internal as well as external ribs to provide double the normal surface area for faster heat dispatch. To guard against shock the lamp is cradled in high-temperature rubber and to seal the unit rain-tight and water-tight for use in any position (even face up) the lamp is doubly protected with rubber gaskets.

The No. 64 floodlight also is available as a portable or wall type unit. A complete line of interchangeable wiring troughs, splice boxes, wall and pole fittings for mounting cluster combinations makes it highly effective for many multiple applications.

Get the facts on the new No. 64—send for Bulletin No. 140.


LAMPHOLDERS


CLUSTER LIGHTS


VAPORTIGHT

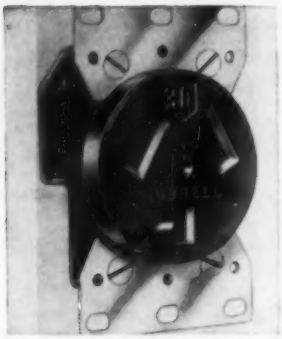

ISLAND LIGHTS

For outdoor lighting - It's Stonco

Stonco

ELECTRIC PRODUCTS CO.

Kenilworth, New Jersey



in single-gang box while outside holes permit mounting for 2-gang box or 4-in. square box. Both the 30-amp unit, Cat. No. 9350, and the 50-amp unit, No. 7960, are available grounded and ungrounded. Each is listed by U.L.

Harvey Hubbell, Inc., Bridgeport, Conn.

Luminaire (33)

A new luminaire UA-20, for lighting service station pump islands and other outdoor areas may be adjusted vertically and horizontally for optimum distribution from its 400-watt E-Hl mercury or J-Hl fluorescent mercury lamps. Completely weatherproof, the reflector is made of heavy gauge steel finished in white porcelain enamel on reflecting surfaces. All exterior surfaces are finished in light gray enamel. Fittings are designed so that they may be rigidly clamped to a 2-in. unthreaded pipe.

Westinghouse Lighting Division, Edgewater Park, Cleveland, Ohio.

Radiant Heating (34)

A Glassheat panel to fill every heating need is available in the new deflector top series. These electrically operated units are constructed of specially tempered "Hammertone" finish glass fused with aluminum strips. Infrared rays, projected by means of a metal reflector behind the glass, heat you directly. A thermostat in each room. Outside frames are finished in a neutral "Seafoam" green and may be

A New Name

in the CONDUIT FITTINGS INDUSTRY!

These Outstanding Features Make Your Work Easier!

1. UL APPROVED!
2. MADE OF CAST MALLEABLE IRON, STRONG—RUGGED—DURABLE!
3. MORE WORK AREA INSIDE FITTINGS—SCREWS IN CORNERS —NO OBSTRUCTIONS!
4. GROUND SURFACES GIVE TIGHTER COVER AND GASKET SEAL!
5. HOOKS AND LOOPS ADDED TO RECTANGULAR TYPES FOR YOUR NEEDS—MADE TO ORDER FAST!

Gives You Everything You Need to Provide Fast Starts and Completions on Your Jobs!

Ideal-Simplet Conduit Fittings are a broad, flexible line of *quality* products. They are designed to help you meet the requirements of specific installations. You can lay out systems according to *your* best interests — no necessity for specifying allied products not completely suited to your needs. You *get* the fittings *you* want...no "extras" required!

What's more, Ideal-Simplet fittings are delivered to you *fast*... when *you* want them. And, field service help is available when needed. The style categories listed indicate only some of the more popular fittings. Look them over — *and ask for them by name on your next job*...IDEAL-SIMPLET CONDUIT FITTINGS!

Write for Complete Catalog Information and Where to Get Them!

IDEAL SIMPLET *Quality* PRODUCTS

• RECTANGULAR SIMPLETS

with covers and receptacles in standard hub styles and sizes. Tapered thread and no-thread. Popular L, LB, C, T, LL, LR, LRL and many others, including double-face and flange units.

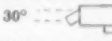
• FS AND FD SIMPLETS

Threaded and no-thread series. Single and gang units with device interchangeability feature. Covers include cast vapor tight types with cork or neoprene gaskets.

• ROUND SIMPLETS

Includes G, H, SE, SEH, P, PM, OS and OSL, etc. series, in variety of hub styles and sizes. Cast or steel covers with cork or neoprene gaskets. OSL types ideal for embedding in concrete!

• SIMPLET WEATHER-PROOF JUNCTION AND PULL BOXES



Used in subways, underpasses, etc. Type A with 4 hubs, type B with 4 hubs at convenient 30° down angle. Extension ring gives greater depth, fits smaller diameter devices.

• VAPORTIGHT SIMPLETS LIGHTING FIXTURES

For universal application. Assorted sizes and styles including popular VW for masonry walls, VU for exposed systems, VO for mounting to sheet metal boxes. Same base with adapter makes changeover from 100-watt to 150 or 200-watt units. Long-lasting aluminum parts. Accessories and reflectors available.

• HANGING DEVICES

Include the ALC for use with incandescent systems. Accessories, trigger hook lock assemblies, pendant loops, etc., available.

• VAP-OIL-TITE CONNECTORS

For use with liquid-tight flexible conduit. Provides positive seal, prevents costly shorts and down-time!

• "FRICTION-SET" FIXTURE HANGERS

...align lighting systems with a twist of the wrist. Complete assembly.

• NEW! LOW-COST FIXTURE HANGER

With 38° total adjustment. Fast, low cost mounting. With chains, hooks and cord clips.

SIMPLET FITTINGS DIVISION • IDEAL INDUSTRIES, INC. IDEAL

1041 Park Ave., Sycamore, Illinois

NEW SYNCRO-CURE!

makes it possible to put 67.32% Neoprene into...

far in the lead in flexibility!

You can actually see a new texture—a new look of quality reflected in the smooth, tough hide of Synchro-Cured Bronco 66 Certified. Black and rich, the Certified jacket gleams with quiet strength, ready flexibility. Tests have proved that Bronco 66 Certified is 20.33% *more flexible* than the average of all competitive cords tested, including widely-advertised brands.

The increased flexibility which results from the new Synchro-Cure process increases the value of Bronco 66 Certified to you

- **66 Certified flexibility lessens worker fatigue...**
- **Stays put; doesn't snake its way under the business end of cutting tools...**
- **Lies flat; eliminates hazard to traffic.**

manufactured by
WESTERN INSULATED WIRE CO.
LOS ANGELES 58, CALIFORNIA

now available internationally through Electrical Wholesale Distributors

WRITE FOR NEW FREE CATALOG

BIG CABLES, TOO are Synchro-Cured and extra flexible. Flex a piece of size 1, 4 conductor..."incredible flexibility." Cables are wound on 250', 500', and 1000' returnable reels.

BRANDED*... Every 2 feet, vulcanized into the jacket, appears "Bronco 66 Certified—67.32% Neoprene," type, number of conductors, size, voltage, and P116BM—approval number of the Pennsylvania and U. S. Bureau of Mines.

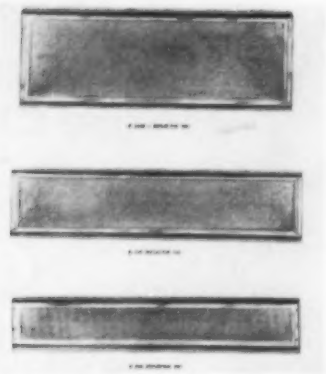
BRONCO 66 CERTIFIED is made in a full range of types and sizes:

TYPE	SIZES	COND.
SO Cord	18-10	1 to 4
Control Cable	18-10	5 to 24
W or G	8-1/0	2 to 4
Single Cond.	18-4/0	
Welding Cable	8-4/0	

also Type SJO and SV-Neoprene

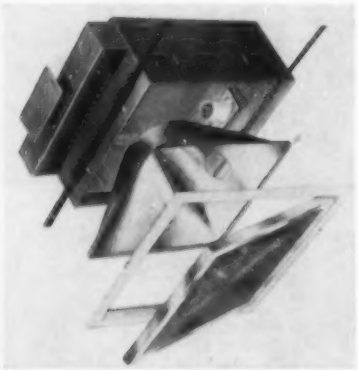
Another first from BRONCO!

* PATENT PENDING



painted over to match any decor. They can be surface mounted or recessed. Units are 120 and 240 volts, 750, 1000 and 1500 watts. Literature is available.

Continental Radiant Glass Heating Corp., 1 *East* 35*th St., New York* 16, *N. Y.*



Incandescent Unit (35)

A prewired recessed incandescent downlight that is 78% efficient. Unit is Underwriters' Laboratories approved for use with lowest cost building wire. A choice of size, wattage and wide variety of interchangeable lenses and diffusers make these units very flexible. Duraflex reflector is used. Ceiling frame, pressed from heavy gauge steel, is finished in baked white enamel; lens frame is fabricated of stainless steel; fixture housing is of heavy gauge steel. Literature is available.

Litecraft Manufacturing Corp., 8 *East* 36*th St., New York* 16, *N. Y.*

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Mr. E. L. Bailey of City Electric Company, Albuquerque, New Mexico.

"Day-Brite fixtures save our time"

The beautiful Simms Building, Albuquerque, New Mexico—one of City Electric's recent jobs.

"When we unpack Day-Brite fixtures, all the parts are there for each and every fixture.

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"Naturally, all this saves our time and helps us make a clean profit on the job."

Mr. Bailey is one of hundreds of contractors throughout the country who have good things to say about Day-Brite. The more Day-Brite fixtures *you* install, the more good things *you'll* have to say about them.

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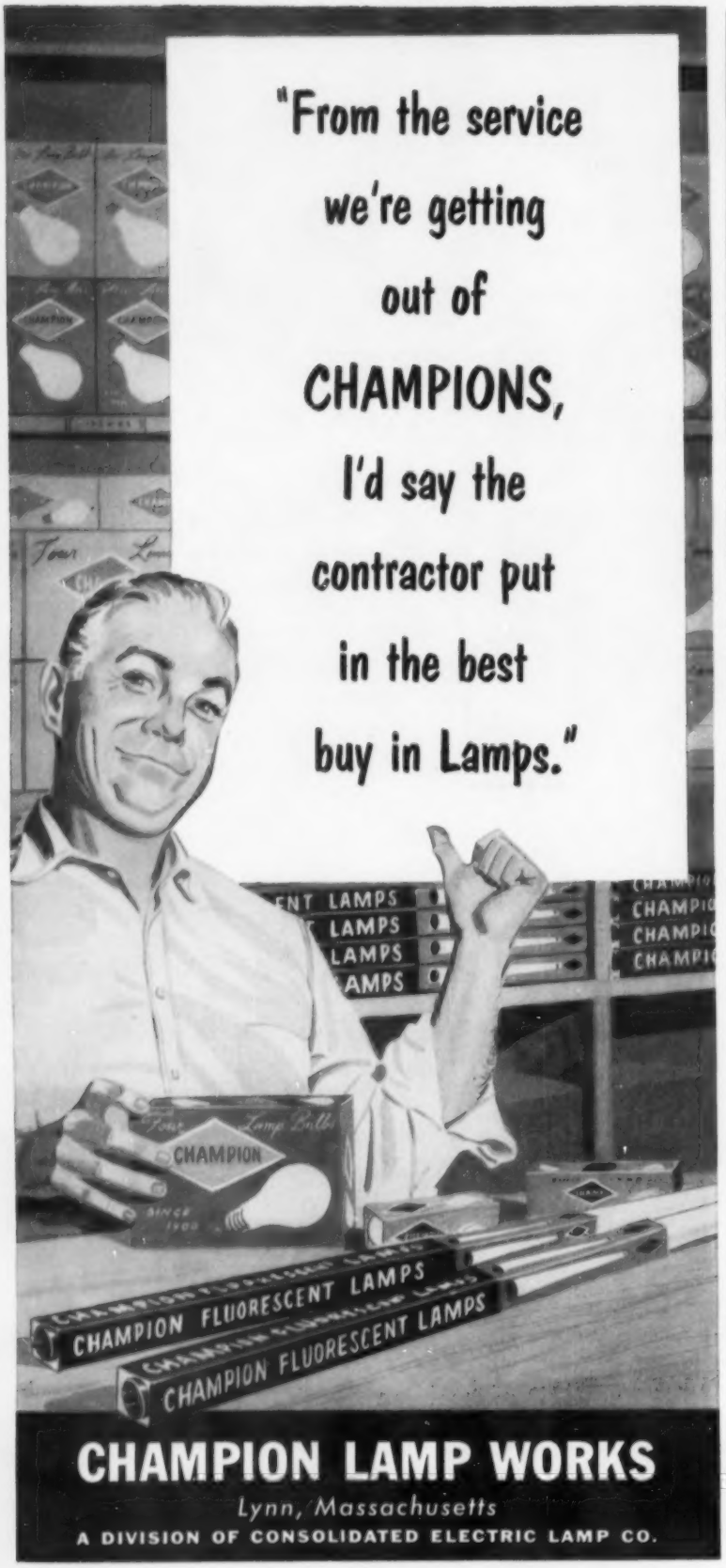


CATALOGS and BULLETINS

(37) STATIC CONTROL SYSTEMS are discussed in booklet B-6584 entitled "The Whys and Wherefores of Cypak". Booklet covers the need for the equipment; applications and descriptions of the Cypak systems. Westinghouse Electric Corp.

(38) BUSWAY SYSTEM designed for general-purpose power distribution incorporates either aluminum or copper enclosed bus-bar system, is available in 600- to 4000-ampere rating. Bulletin GEA-6151, 16 pages, gives technical and installation data. Distribution Assemblies Dept., General Electric Co.

(39) OIL LEVEL CONTROLS, oil cups and bottle oilers are illustrated and described in 4-page circular 580. Dimensions and installation instructions for a wide range of applications. Lunkenheimer Co.

(40) SERVICE MAST KITS for low roof residences are described in 4-page bulletin P-1255. Illustrations of components and accessories for 2- and 2½-in. masts are included with installation diagrams. Hubbard & Co.

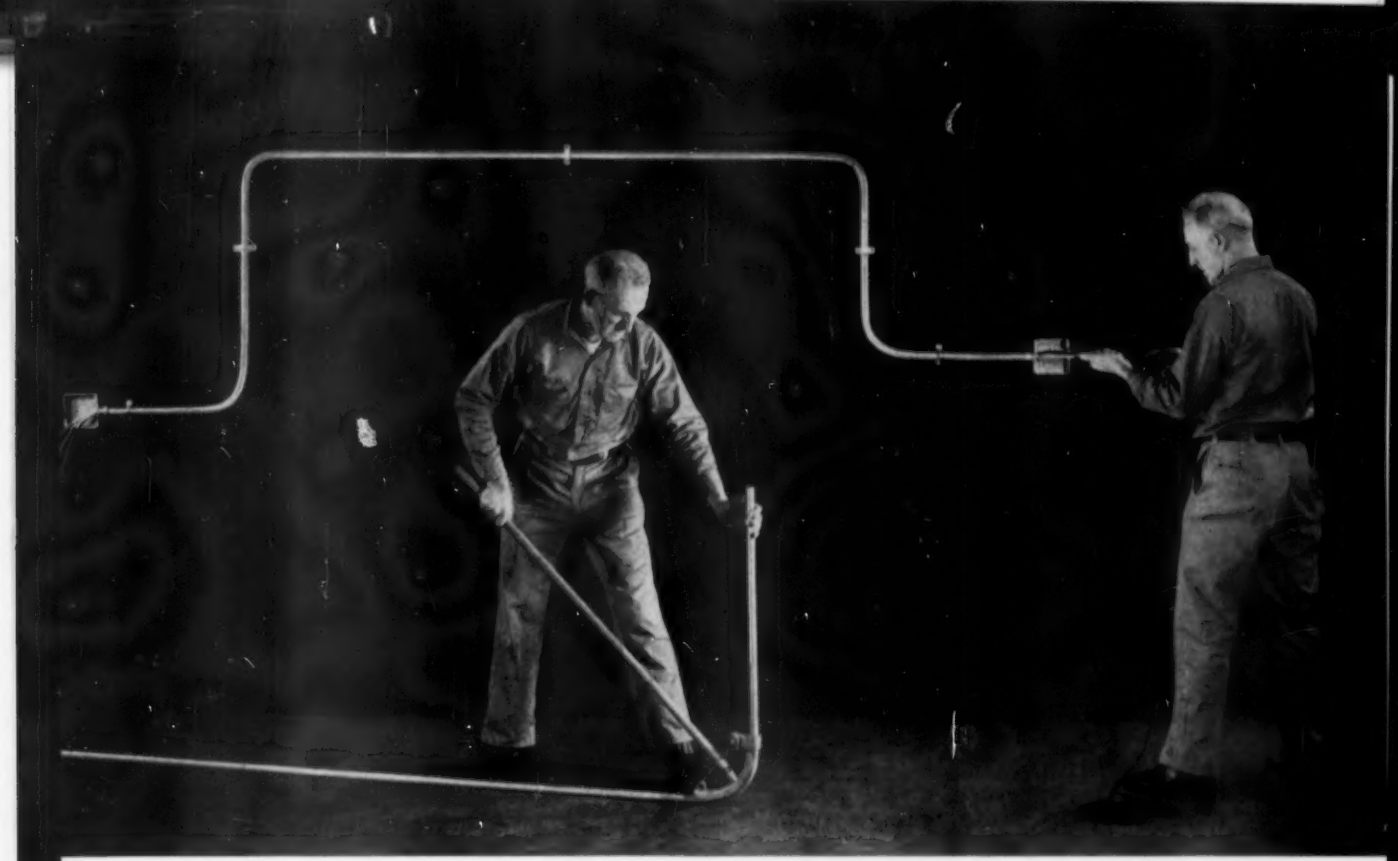
(41) MOTOR INSULATION: Folder TE-55-50, 6 pages, describes properties and performance advantages of Fiberglas materials as motor insulation. Owens-Corning Fiberglas Corp.

(42) VISUAL ALARM SYSTEMS is the title of a 32-page catalog covering components, wiring, and applications of annunciators for protection and control of equipment and processes. Design and ordering data is also featured. Autocall Co.

(43) ELECTRIC HEATING for the home is discussed in 20-page booklet B-6709. Topics covered include residential heating requirements, advantages of electric heat, characteristics of various methods, and costs. Westinghouse Electric Corp.

(44) FLUORESCENT FIXTURES and mercury vapor lighting are featured in the combined catalog of commercial, industrial, residential and outdoor equipment. Great Northern Manufacturing Corp.

(45) DRAFTING. Time saving techniques of modifying drawings through use of intermediates are discussed in 16-page booklet en-



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Continuous weld seam on G-E EMT makes installation easier

Because the continuous weld seam on General Electric EMT eliminates weld metal, there are no burrs to snag conductors or tear insulation. General Electric's strong welded seam won't split or cause flattening during bending. *Controlled, continuous induction welding makes the difference.* G.E. adopted induction welding because it eliminates the sewing machine-like "stitch" produced by other types of welding. Induction welding means easier handling and faster wiring. General Electric EMT also offers these additional advantages:

COLORED BUNDLING TAPE for quick indication of size.

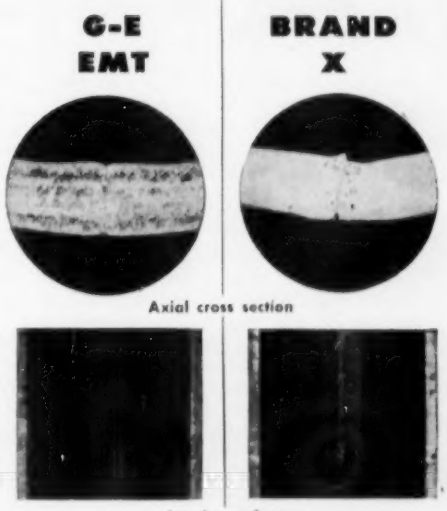
EASY BENDING because only the finest cold-rolled steel is used.

FAST WIRE PULLING because of the low-friction interior surface provided by Glyptal* lacquer and the smooth welded seam.

EXCELLENT CORROSION RESISTANCE because the interior is protected with tough Glyptal lacquer, and the outside is coated with electro-galvanized pure zinc.

FIND OUT how you can speed your wiring jobs with G-E EMT. See your General Electric Construction Materials distributor or write Section C60-318, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

*Registered Trade-mark General Electric Company



You can see the difference in these photographs. Compare axial cross section and interior surface of G-E EMT (left) with competitive brand (right). G.E.'s smooth weld is produced by continuous induction welding—and only General Electric EMT has it.

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GENERAL ELECTRIC

GREENLEE CABLE PULLER speeds and simplifies wiring installations

pulls cable through all types of conduit... open or concealed

Here's an on-the-job view of a standard GREENLEE Cable Puller with a flexible elbow attachment making simple work of what could have been a mighty tough job.

In about five minutes, three 1,000,000-circular-mil cables were pulled through an 80-foot length of 4-inch conduit which is some 18 feet above the floor level. Setup time included, the entire job took approximately an hour and was handled simply, easily.

Whether you have high overhead jobs like this calling for the use of the attachment, or more routine work, you'll find the GREENLEE Cable Puller a big timesaver that helps get the job done faster, at lower cost. With it you *pull in line with the conduit.* When used without attachments for concealed conduit work, it clamps directly on the conduit. You get a fast, easy pull without straining conduit hangers and eliminate heavy, cumbersome equipment. Use it for open or concealed conduit . . . high up, in close quarters, or out in the open.

It's a powerful puller . . . exerts a maximum pull of 7,500 pounds and has two speeds: one for fast work, the second for a steadier, heavier pull.

Portable, easy to carry, set up and operate. Write today for complete reference folder on this and other GREENLEE timesaving tools for electricians. Greenlee Tool Co., 1743 Columbia Avenue, Rockford, Illinois.

TOOLS FOR CRAFTSMEN
GREENLEE

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hydraulic Conduit Benders • Tubing Benders • Auger Bits and Drills • Knockout Punches • And many more

titled "11 Ways to Save Drafting Time". Frederick Post Co.

(46) DC MAGNETIC BRAKE is self-adjusting to eliminate need for frequent checking and manual adjustments. Booklet B-6548 describes construction, operation and applications; also use of the unit with ac motors by means of rectifiers. Westinghouse Electric Corp.

(47) CENTRIFUGAL BLOWERS for expelling corrosive air fumes and gases in a temperature range of 40 to 140 degrees F. Units are constructed of un-plasticized rigid polyvinyl chloride and are available in four impeller diameters up to 27-in. Performance, application and chemical characteristics are listed. Bulletin 102. Industrial Plastic Fabricators Inc.

(48) DC METERS of the permanent-magnet, moving coil type are covered in 8-page catalog section 40-55. Design, application and ordering information is given on ammeters, voltmeters, millivoltmeters. Esterline-Angus Co., Inc.

(49) LUBRICANTS. Synthetic Ucon fluids and lubricants feature physical chcaracteristics differing from animal, vegetable and mineral oils. High viscosity indexes, low pour points, and excellent lubricity and basic properties; others are non-carbonization, sludge resistance and lack of deteriorating affects on metals and rubber. Form 6500D, 52 pages. Union Carbide and Carbon Corp.

(50) HERMETIC TERMINALS of annulated type are constructed of high alumina ceramics and metallized with NICOTE. Engineering data sheet 1055 gives advantages, available sizes and dimensions. Frenchtown Porcelain Co.

(51) RESIDENTIAL LIGHTING UNITS, including a broad selection of pull-down fixtures are illustrated and described in 4-page form M-3527. Markel Electric Products, Inc.

(52) PORTABLE HEATERS of the infrared fused glass type are illustrated in 4-page folder H73ER which also covers advantages and ratings. Electromaid Corp.

(53) POWER HACK SAW cuts installation and maintenance costs. Construction features, uses, and instructions of the four Key-Hak models are given in 4-page folder. Key-Hak Div., Producers & Distributors Inc.

(54) TRANSLIGHTED CEILINGS. Two booklets. Catalog section 8, 16 pages, gives essential engineering

data and installation methods of Luve-Tile electric ceiling. Section 8A is a 16-page sketch of design ideas for employing this system which consists basically of 1 ft by 1 ft eggcrate louver elements clipped together; further installation tips are included. J. A. Wilson Lighting & Display.

(55) BATTERIES of flat-plate construction feature high power, electrical efficiency, coupled with low operating costs. Form 5785, 4 pages, covers materials and design of the Powerclad line of industrial batteries. Exide Industrial Div., Electric Storage Battery Co.

(56) SERVICE ENTRANCE SWITCH of the pressure load break style features bolted silver contacts. Bulletin 1255, 4 pages, gives results of performance tests specifications and descriptions of design advantages. Pringle Electrical Mfg. Co.

(57) INSTRUMENTS and gages for a wide range of measuring purposes are detailed in 16-page bulletin 10-56. Included are basic performance data, applications and design features. James G. Biddle Co.

(58) FANS for window mounting have pushbutton control and Frigidial thermostatic control. Operating characteristics, capacities and list prices are included in 4-page folder. Frigid Inc.

(59) VIBRATION MOUNTINGS of the rubber-in-shear type are the subject of 4-page catalog RS-55 which covers dimensions and design features of the line plus selection data. T. R. Finn & Co., Inc.

(60) TRANSFORMERS filled with fireproof Chlorextol insulating liquid may be employed indoors without need for costly vaults. Folder 61B6043C, 4 pages, describes features of this new insulating medium and range of transformers in which it may be used. Allis-Chalmers Mfg. Co.

(61) PLUG-IN BUSWAY, designated type FVK Flex-A-Power, permits direct connection of light and power loads to secondary feeders. Available in copper or aluminum in ratings from 225- to 1000-amperes. Bulletin GEA-6470, 20 pages gives technical data. Distribution Assemblies Dept., General Electric Co.

(62) HACK SAWS. Two booklets cover use and maintenance of hand and power hack saws including such items as selection of proper blade for the job, how to tension the blade, detection and elimination of sawing difficulties, and tips on safety. Capewell Mfg. Co.

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Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Loading Series Multiple Transformers

QUESTION N29—We have a great many series-multiple transformers which are used to connect small loads to 6.6-amp series street lighting circuits.

There is a sharp difference of opinion as to procedure when removing the multiple load but leaving the transformer connected in the series circuit. Some say just to tape up the ends of the multiple winding. Others say they should be short-circuited like an instrument current transformer.

The transformers are made by a number of different companies and range from 400 watts to 2 kw.

I would like some opinions, with reasons.—J.H.B.

ANSWER TO N29: In a conventional voltage transformer a load increase in the secondary increases the secondary amp turns. These secondary amp turns are opposite in polarity to the primary amp turns (being a voltage rise as opposed to a voltage drop in the primary) and the net flux decreases. More primary current flows in the primary to restore the net flux to its former value, keeping it practically constant. In other words, the load on the primary follows that demanded by the secondary.

In a current transformer the load on the primary is independent of the load on the secondary. The primary amp turns being fixed, the load on the secondary is fixed and the flux in the core is the flux due to the net difference of the primary and secondary amp turns. It is usually of a low value, far below the knee of the magnetization curve of the transformer.

If the secondary load is removed, that is, the windings left open, the flux in the core will be due to the unopposed primary amp turns. In numerical value this flux will be very great and will give rise to a very high and dangerous voltage in the open circuited secondary. This voltage may puncture windings and be harmful to life. Therefore the windings should be shorted before the load is lifted, and left shorted. No harmful secondary circulating current will flow, as the heavy secondary amp turns will buck the main flux, lowering the net flux, which will in turn, lower the secondary voltage rise. This of course, will limit the secondary current to a safe value and the maximum temperature rise of the windings will be well below the critical value. —J.M.R.

ANSWER TO N29: I can well understand the conflicting ideas concerning this problem, especially since the correct solution depends largely upon the actual characteristics of the transformer and the series circuit.

Personally, I would consider it bad practice to attempt to obtain 120-volt power from a series lighting circuit. It is a method that would be at best risky, and at worst downright dangerous. There is a great hazard that an open circuit in the 120-volt transformer secondary would result in several thousand volts being available at the fault point, and it is not hard to picture what can happen when 120-volt equipment is subjected to such potentials.

Rather than actually answer the question I would strongly recommend that you transfer the 120-volt loads to a conventional constant voltage system before you experience a very serious accident. —D.H.N.

ANSWER TO N29: There are several basic reasons why a series-multiple transformer should have the secondary shorted when the load is removed.

1) Depending on the internal construction, the primary impedance of the transformer will increase from 1.5 to 4 times when the secondary load is removed. Most units will have an increase of 2.5 times. This increase is reflected in a like increase in primary voltage. This greater primary voltage tends to overwork the core, which is evidenced by a marked increase in the heat rise of the transformer. Prolonged operation at these higher temperatures will do the transformer no good.

The opposite condition is true when the transformer is shorted. The primary impedance approaches zero. As there is only a slight increase in secondary I^2R losses, no increase in primary I^2R losses and a large decrease in core losses, the transformer will run much cooler on short circuit than it does on normal load. This is an advantage.

2) If a large number of units were left on the line, simultaneously, on open circuit, the increase in line V.A. could quite possibly exceed the capacity of the source regulator. Conversely, if the same number of transformers were operated on short circuit, a lower line V.A. would be realized and result in a power saving.

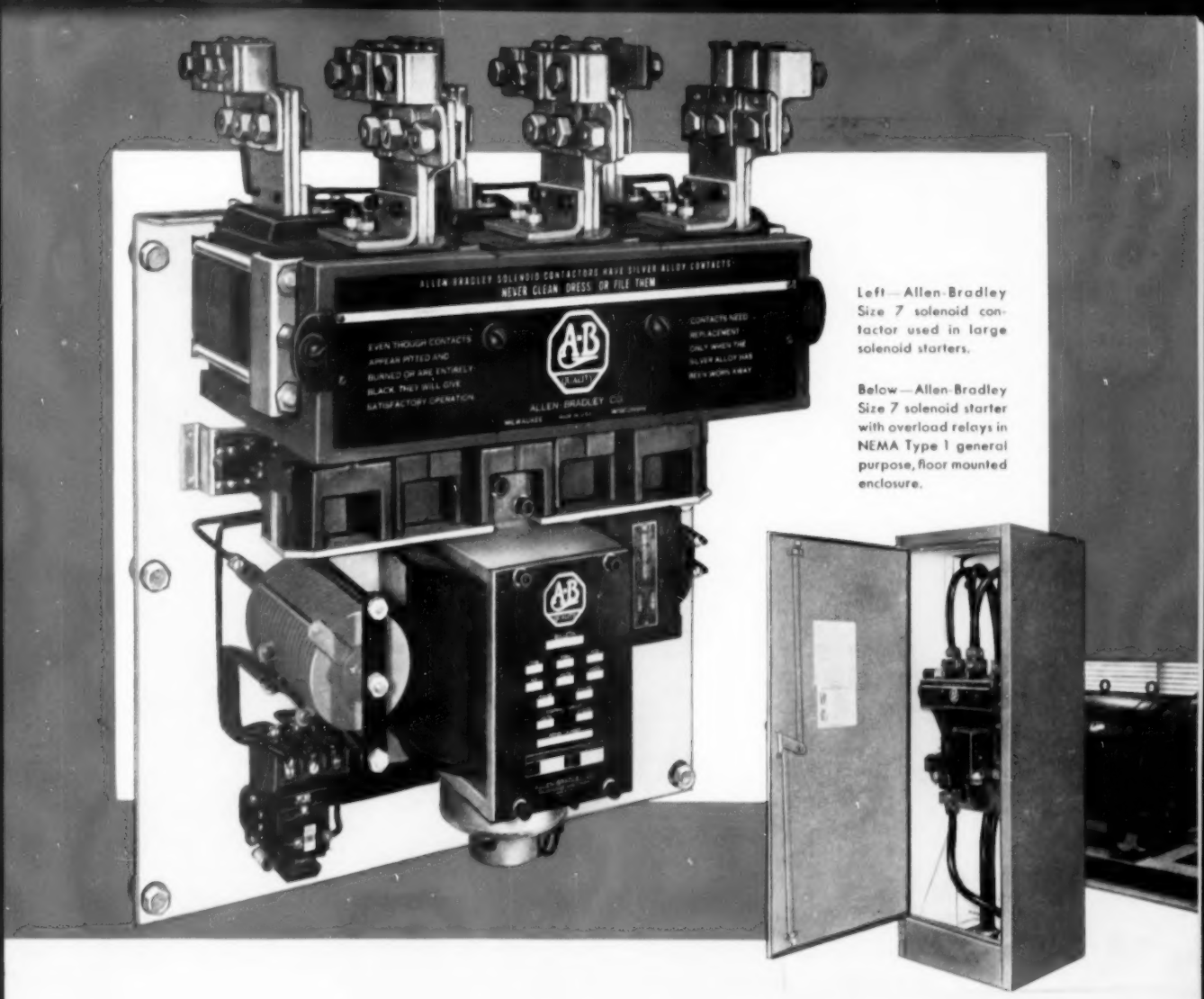
3) When a series transformer is operated on open circuit, the high core saturation causes an increase in line harmonics. If a sufficient number of transformers are left on open circuit, the increase in line harmonics (distortion) will cause loss of lamp life.—V.W.O.

ANSWER TO N29: When removing the load from a street lighting current transformer, a very high voltage will be built up in the secondary windings, unless it is short circuited before hand. This is because the primary and secondary magnetic fields oppose each other; as soon as the latter is entirely omitted, then the secondary coil conductors will be "cutting" far too many lines of force. Different than a voltage transformer, the primary current is not limited at "no load" with inductive reactance or "self-induction."

There probably is not as much burn-out danger in this transformer as in one designed for use with instruments, on account of less efficiency and accuracy in constants and characteristics. For instance some doorbell transformers can have the bell circuit "shorted" without burning out, because the efficiency reduces so much.

However your danger to personal shock is very great with the open secondary, and neither tape nor insulation can be depended upon, unless you have some automatic discharging equipment—either external or a built-in resistance.

A check with the manufacturer certainly would relieve you of all responsibility in this matter and perhaps be the only way for 100% safety.—M.C.T.



Left—Allen-Bradley Size 7 solenoid contactor used in large solenoid starters.

Below—Allen-Bradley Size 7 solenoid starter with overload relays in NEMA Type 1 general purpose, floor mounted enclosure.

ALLEN-BRADLEY SOLENOID STARTERS USE DOUBLE BREAK, SILVER ALLOY CONTACTS THROUGHOUT!

Eight Sizes up to 300 hp, 220 v; 600 hp, 440-550 v.

Bulletin 709 solenoid starters shown here in Sizes 0 to 6—all equipped with accurate and reliable overload relays.

All starter manufacturers use the solenoid construction and double break, silver alloy contacts for their lower starter ratings, because experience has proved this construction superior to any other. Therefore, wouldn't this experience repeat itself with the higher rated starters?

Allen-Bradley has found this to be absolutely true. Its starters of high hp rating are regularly establishing new standards of starter performance. As you go from size to size, the operating characteristics remain the same—you get trouble-free, long-life performance.

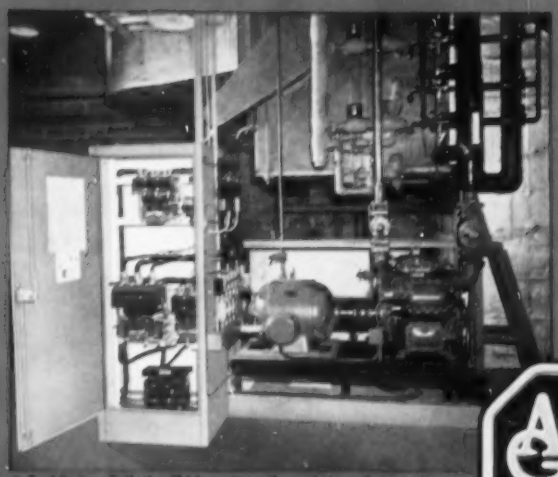
Standardize on Bulletin 709 solenoid starters—they are Tops in Quality!

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

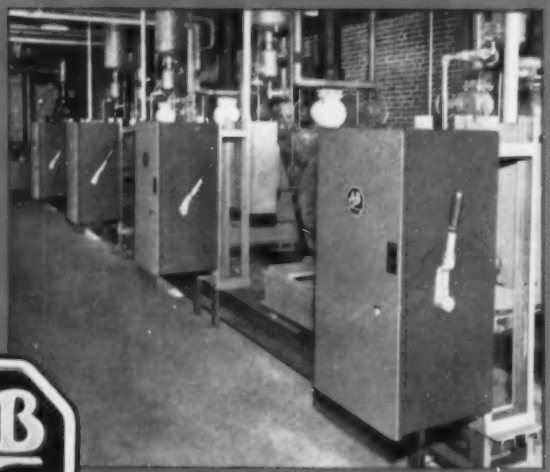
3-56-MR

A-B Quality

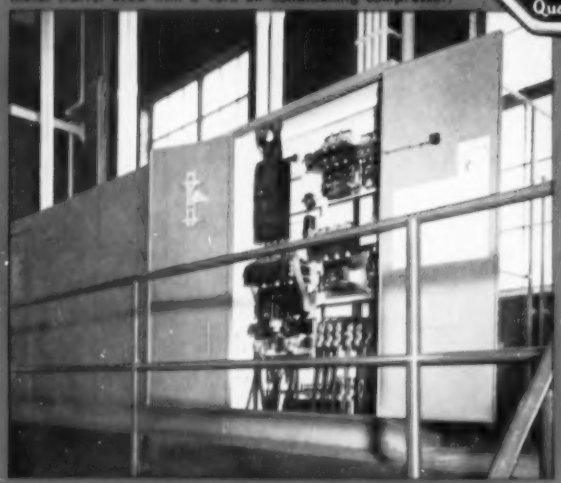
ALLEN-BRADLEY
SOLENOID STARTERS
QUALITY



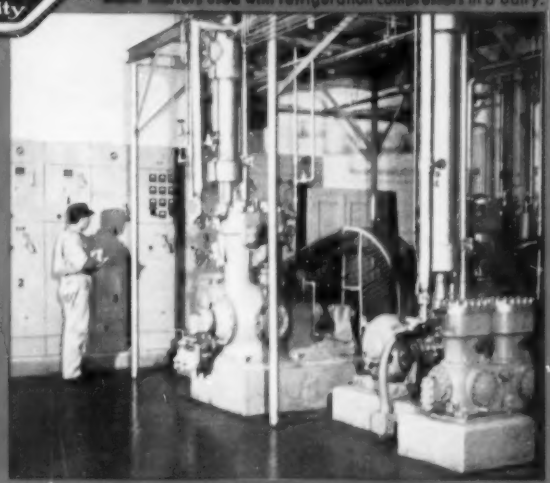
A-B 60 hp Bulletin 746 automatic autotransformer-type motor starter used with a York air-conditioning compressor.



Four A-B 125 hp Bulletin 646 manual autotransformer-type motor starters used with refrigeration compressors in a dairy.



A row of A-B 350 hp Bulletin 761 automatic slip-ring motor starters with circuit breaker disconnects in the Milwaukee sewage disposal plant.

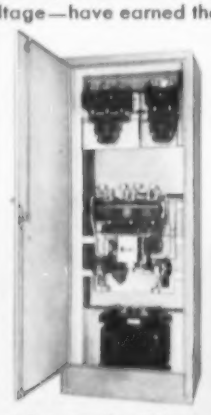


Allen-Bradley Bulletin 798 multi-unit control center used with motors ranging from 10 to 75 hp installed in a southern Kraft food plant.

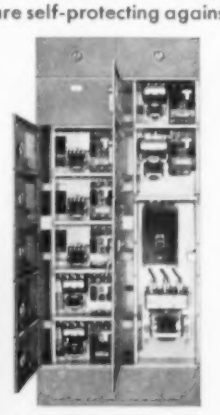
ALLEN-BRADLEY STARTERS FOR LARGE A-C MOTORS ARE AS POPULAR AS THE BULLETIN 709 SIZE 1 FOR SMALL MOTORS

Allen-Bradley manual and automatic starters for large squirrel-cage, slip-ring, and synchronous motors—both high and low voltage—have earned the same reputation for "Quality" for which the lower ratings are known. Every operating requirement can be satisfied, either with individual units or as sections of a multi-unit control center.

Allen-Bradley high voltage starters are rated up to 1500 hp with voltages ranging from 2000 to 4600 volts. The high voltage, synchronous motor starters are self-protecting against short circuits up to 250,000 kva on 2501-4600 volts, 3 phase, 60 cycles. Oil or air break switching available. Please write for the Handy Catalog.



A-B automatic autotransformer, reduced voltage starter with cabinet open to show control panel.



A-B multi-unit control center with compartment doors open to show various types of motor controls.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY
SOLENOID STARTERS
QUALITY

3-56-MR

Identifying Type of Motor Winding

QUESTION P29—After a motor stator was cleaned of its winding and the nameplate removed, would it be possible to determine whether it has been a delta or star connection? The wire and coil size can be taken from the removed coils. Is there any reference book which deals mainly with winding of motors, also including sizes of wire and number of turns to use on the different motors?—E.H.

ANSWER TO P29: A motor stator which has been cleaned of its winding and the nameplate missing can have its connection determined by the way in which the coil groups are connected. If the finish leads of the coil groups are tied together with the start leads being used as line leads, then the connection is a single circuit star. On the other hand, if the coil groups are connected in series and the line leads are brought out from the junction of each then the connection is a single circuit delta. Single circuit star and delta connections are used when the motor is to be used on one voltage. Two-circuit star and two-circuit delta wound motors are used when the motor can be operated from 220 or 440 volts, 60-cycle, 3-phase, or 110-220 volts, 60 cycle, 1-phase or in other words, dual voltage motors. Also, speed and the number of poles are proportional. If the number of poles are reduced by one-half, the speed will double.

Other data which must be obtained before the winding is discarded is as follows:

(1) Number of turns per coil.

(2) The type of magnet wire used must be observed. Whether it is single cotton enameled, double cotton enameled or Formvar magnet wire.

(3) The thickness of slot insulation must be observed.

(4) Length of slot insulation beyond stator core.

(5) Length of straight sides of coils beyond stator core.

(6) Length of center of coil beyond stator core.

Factors which can be formulated are as follows: (A) coil span, (B) number of coils per group, (C) electrical degrees per slot, and (D) number of poles.

Although there are some very good books on the market on motor repairing and rewinding, I believe what you would be more interested in is a service manual on electric

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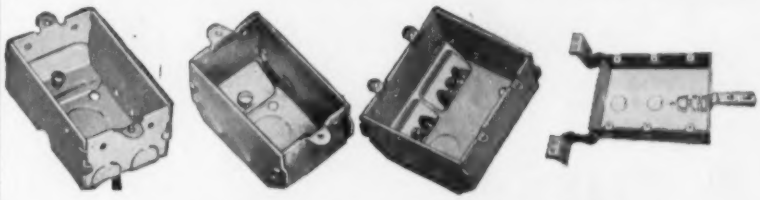
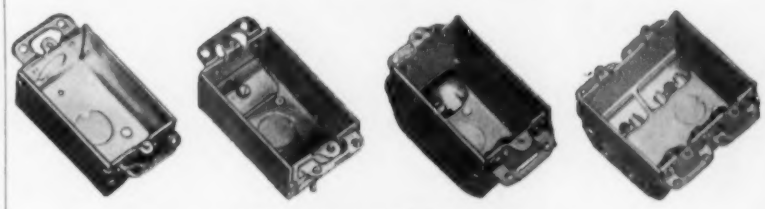
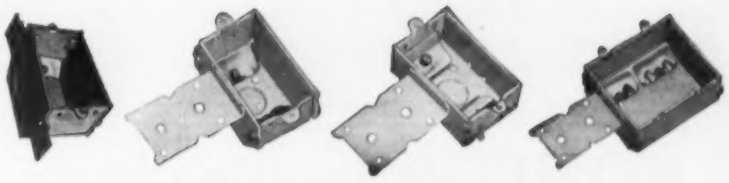


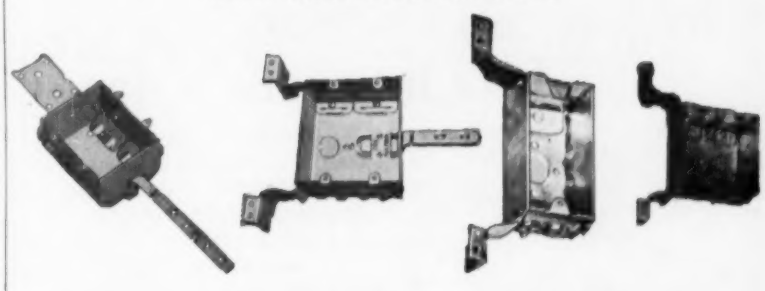
NAIL-IN TYPE—ONE AND TWO GANG



WITH MOUNTING EARS



WITH MOUNTING BRACKETS



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motors which could be gotten through the various manufacturers of electric motors.—L.C.D.

ANSWER TO P29: An excellent book on rewinding motors is "Electric Motor Repair," by Robert Rosenberg, B.S., published by Murray Hill Books, Inc., N. Y. (Mr. Rosenberg is an instructor in Armature Winding & Motor repair at the Brooklyn High School of Specialty Trades, New York City.) This is a very practical and thorough book on the winding, repair and trouble shooting of ac and dc motors and controllers.

The technical information, along with the many excellent illustrations given in this book will enable the reader to solve his problem of determining whether the cleaned stator was a delta or a star connection.—R.A.M.

ANSWER TO P29: After a motor stator is stripped and cleaned it is possible to determine the connection by examining the leads and cross connections of the stripped winding. If no star point is in the scrap wire the winding was connected delta. If it does contain a star point it was star connected. Some windings have more than one star point but this condition can be determined by examination of the scrap wire.

After it has been determined whether the winding was star or delta, the number of circuits can be found by an examination of the terminal leads in case of a delta connection, or the star point in case of a star connection.

In case of a star connection there is a circuit for each coil connection to the star point from one phase.

In case of a delta connection there is a circuit for each two coil connections to the terminal lead per phase.

The above is true for single voltage motors. In the case of dual voltage motors it applies to the high voltage connection.

Regarding reference books there are three books available which are indispensable to any motor repair shop. They are: Connecting Induction Motors—Dudley; Winding Alternating Current Motor Coils—Van Brunt and Roe; Fractional Horsepower Electric Motors—Veinott. These books are published by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y.

Regarding data for motors, the National Industrial Service Association furnishes a tremendous coverage of motor data to its membership.—J.E.A.

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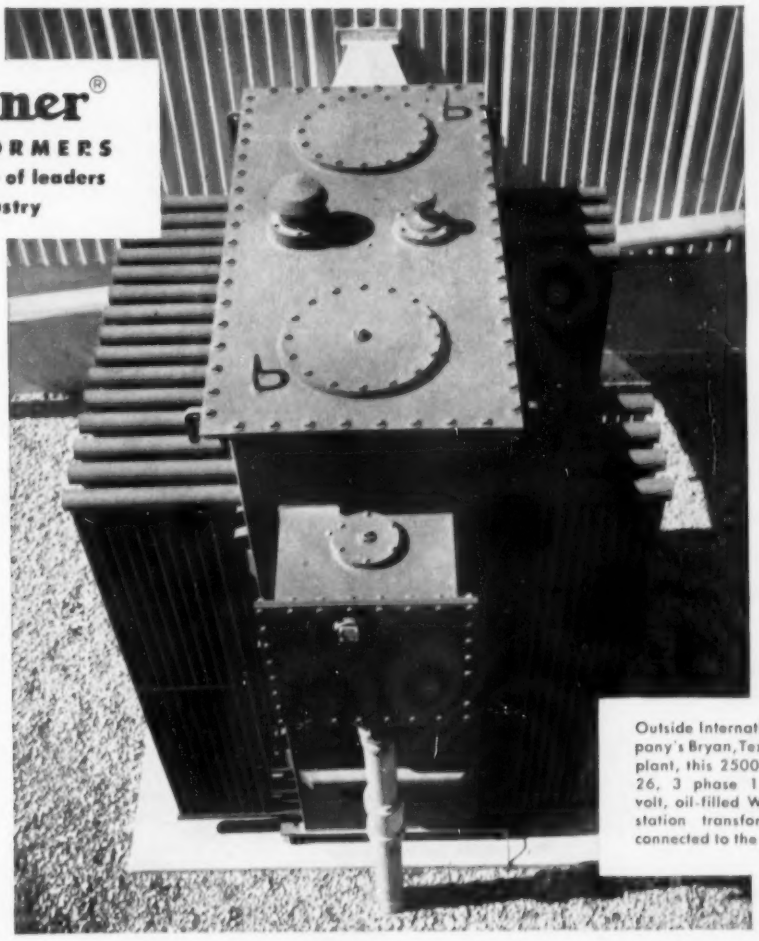

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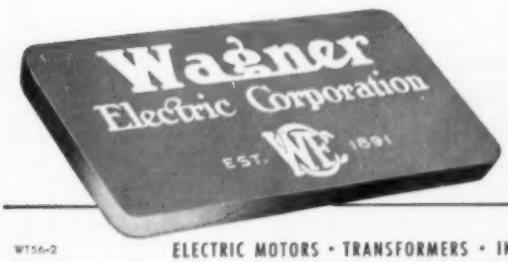

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Use of Isolating Transformers

QUESTION Q29—Where is an isolation transformer used and under what applications is it required by the Code?—R.A.M.

ANSWER TO Q29: In general most transformers, in an incidental manner, are performing an isolation function such as isolating a higher voltage from a lower voltage. With this thought in mind it is assumed that R.A.M. is referring to the specific instances where the isolation is accomplished so an ungrounded (floating) secondary may be used. This may be optional in some cases, but the code specifically requires an ungrounded secondary for some locations.

One of the greatest advantages of the ungrounded secondary from a safety standpoint is that a ground, or partial ground, may exist in any one (but not two) of the legs without causing personnel or property damage. To make the most of this feature a ground-fault-finding system should be utilized. In some installations this is required.

Some of the more common uses of isolation transformers and their code references are given below:

Section 5135 of the NEC *requires* an ungrounded electrical supply in areas where anaesthetics are used. Also required is a ground fault system.

Sections 2516, of the NEC *requires* an ungrounded electrical supply for overhead cranes when operating above combustible materials. The code also requires a ground fault system for this installation.

Section 2517 of the NEC allows ungrounded secondaries of less than 50 volts for appliances in damp or wet locations, or if standing on ground or metal such as boilers etc., providing the primary is less than 150 volts to ground and is grounded.

Section 2514 of the NEC allows ungrounded systems if the voltage is over 150 volts to ground. However, it should be noted that Section 2002 requires a grounded supply if the interior wiring requires a grounded conductor.

Section 2007 of the NEC *allows* ungrounded polyphase installations with special approval of the local inspector.

Section 2515 of the NEC *allows* ungrounded secondaries for furnace circuits.

In conclusion it may be said that the code has only a couple of locations where the ungrounded secondary is a firm requirement, however, the installations where an ungrounded secondary is optional are several.—W.D.J.

ANSWER TO Q29: An "isolation" transformer, as it is referred to here, is a transformer used to isolate the circuit or circuits connected to its secondary side from the supply which energizes the primary side. The voltage may be, at the same time, stepped up or down as in the ordinary application of transformers. But it frequently is used on a one-to-one ratio with the voltage the same on the secondary as on the primary, since the purpose is to isolate rather than to transform a given voltage to a higher or a lower voltage.

Such transformers are required by the Code, unless batteries or motor-generator sets are used, for use on all circuits serving hospital operating rooms or other areas where combustible anesthetics are administered to patients. This is covered by section 5135-f-1 of the 1953 edition of the Code.—W.R.S.

Can You ANSWER These QUESTIONS?

QUESTION A30—I have been told that a Chronotherm which usually requires 5 wires, three for the thermostat and two for the 24-volt clock motor, can be operated on three wires. How can it be wired on a 3-wire low-voltage cable and operate both clock and thermostat?—D.W.

QUESTION B30—What does the design letter and code letter on an alternating current motor tell and how important is it in the selection of a motor for particular application? Does a dc motor have a similar design and code marking? —W.E.G.

QUESTION C30—What special equipment is required to string self-supporting aerial cable for 2300- and 4160-volt overhead plant distribution lines? We use weatherproof and bare copper now with conventional crossarm construction, and hesitate to try cable for fear it will require special motorized equipment for installation because of its extra weight.—D.H.N.

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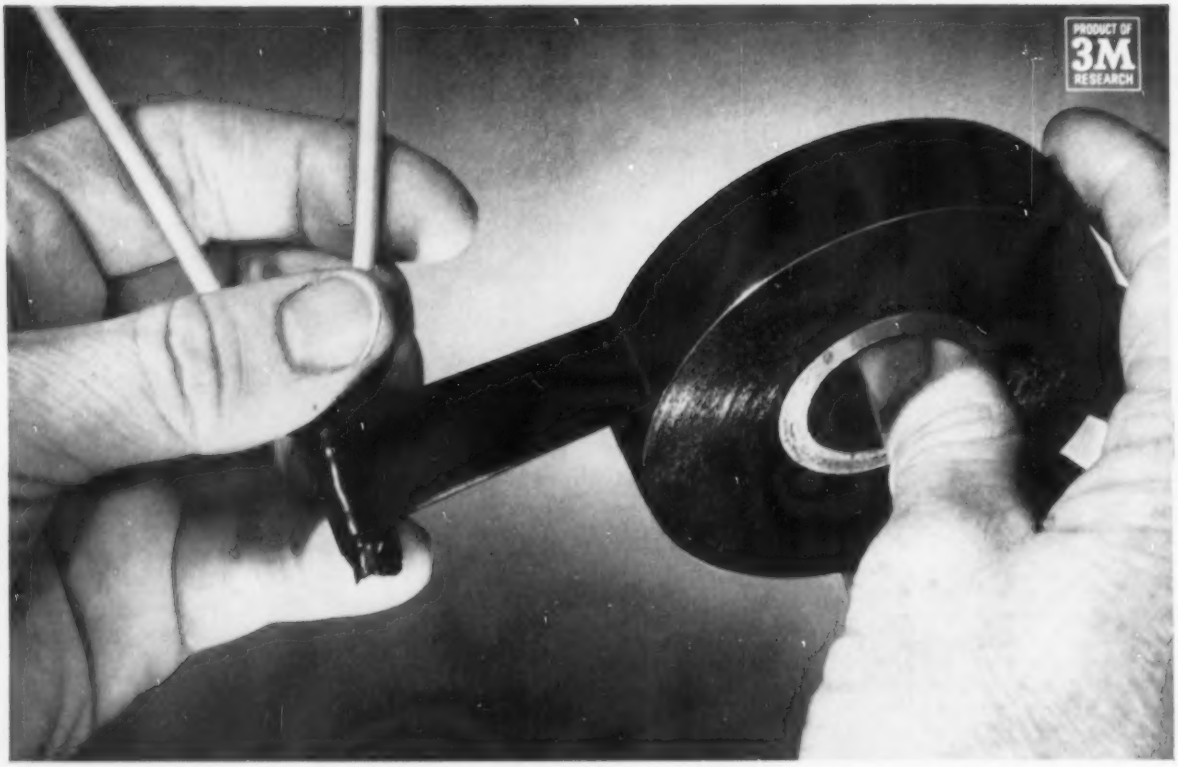

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Questions on the Code

Answered by

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

High Voltage Wiring

Q. *Is it possible to use the new higher voltage 277/480-volt wiring in a hotel property at the present time?*—P.M.B.

A. Section 2113 as yet does not include hotel occupancies among those which may be wired with circuits operating in excess of 150 volts to ground as this section now just provides for industrial establishments, office buildings, large schools and stores. Therefore, until such time as the Code is revised, the use of the higher voltage circuits in hotel properties would be prohibited.—G.R.

Silicone Rubber Insulation

Q. *In the November issue, in discussing the wiring of recessed fixtures, the writer apparently had prepared his answer before the announcement was made of an interim amendment to the National Electrical Code recognizing Type SF fixture wire. This was Interim Amendment No.* 103, *released August* 17, 1955. *UL is currently listing Type SF wire and it is advisable for use in those locations where conditions of temperature and moisture are unfavorable to Type AF insulation.—H.H.W.*

A. You are correct—the discussion was prepared back in July and it does take a bit of time to get this material prepared for publication. This interim amendment has been given a great deal of publicity and has been printed in its entirety in the December, 1955 issue of EC & M on page 154.

To review this, I am again listing below the pertinent facts. Four types are available, viz., Types SF-1 and SF-2 in solid or standard 7 strand construction; and Types SFF-1 and SFF-2 with the flexible stranding. The types "1" are in size No. 18 only whereas the "2"s are in sizes 18 to 14. The maximum operating temperature is 200C and 150C, respectively, for the SF and SFF, the flexible stranding taking a lower temperature because of the smaller individual strands involved in this flexible type of cable.—B.Z.S.

Multiple Service Equipment

Q. *Re:—1953 N.E.Code Section 2357: This section is about service switches whereas 2371-a-3 is about overcurrent devices. Should not the reference to multiple switches be to 2351-a? Also could 2357 be interpreted to require that no circuit breaker be less than 30-amp if six circuit breakers are ganged under 2351? This would seem to be the exact meaning of the words in 2357. Our local inspector is using logic by permitting the use of up to 12 (six pairs with handle ties) breakers provided the service wires are according to 2203. These individual circuit breakers can be down to 15-amp and total substantially more than the service wire rating by Section 2203. Neither the 15-amp nor the total sum is mentioned in Section 2357.*—R.W.K.

A. Section 2351-a covers the Code requirements for a service disconnecting means and recognizes both switches and circuit breakers.

Section 2371 covers the rating requirements for the service overcurrent protection and recognizes both fuses and circuit breakers for this purpose.

Section 2357 covers the rating of the service disconnecting means when switches or circuit breakers are used.

Since a circuit breaker may satisfy the requirements for both the disconnect and the overcurrent protection, they must be covered under Section 2351 and 2371.

I believe the point which you have raised warrants consideration. Section 2351-a definitely recognizes six circuit breakers, or groups of breakers with "handle ties" or handles within ¾ in. proximity as a service disconnect, while Section 2371-a-3 definitely limits the number of circuit breakers used as the service overcurrent protection to six. As a result there appears to be a conflict in requirements which would be eliminated if a reference to the provisions of Section 2351-a was made under Section 2371-a-3.

In answer to your second question, Section 2357 requires that the rating of the service circuit breaker be not less than 50 amps or when multiple breakers are used, breakers as small as 15 amps may be used provided the aggregate installed capacity is 50 amps or more. This point was covered by Official Interpretation No. 396, isued October 15, 1953. I believe the local inspector's interpretation of Section 2357, as outlined by you, is correct. I believe however, in applying this rule, that the provision of the last sentence of Section 2351-a is significant. It reads, "The disconnecting means shall be of a type approved for service equipment and for prevailing conditions." The only assurance for satisfying this provision, with a background of experience and knowledge of the various factors involved, would be the approval of Underwriters' Laboratories.

The last point which you question is one in which several inspectors concur. In the old days of a single main switch or circuit breaker, we had some assurance that the amount of current, to which our service entrance conductors might be subjected, would be limited to a reasonable degree in line with their rated current carrying capacity. With the advent of multiple service equipment applied to the limits now permitted, there is, in the opinion of many, no service overcurrent protection which limits the current to a reasonable degree. It is quite evident on an installation consisting of six 100-amp switches where starting currents of motors are involved that the six sets of fuses would not adequately limit the

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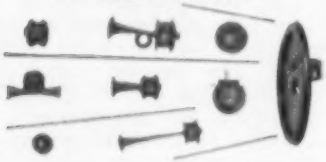

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amount of current that could come over the service conductors. The fundamental rule covered by the first sentence of Section 2304 tells us that "service conductors shall have adequate current-carrying capacity to safely conduct the current for the loads supplied without a temperature rise detrimental to the insulating covering of the conductors etc". According to the introduction to the Code, the fundamental is satisfied when the specific rules which follow are complied with. It appears to me, in the case of multiple service equipment, that the specific rules do not adequately satisfy the fundamental.—B.A.McD.

Services—Official Interpretation No. 418

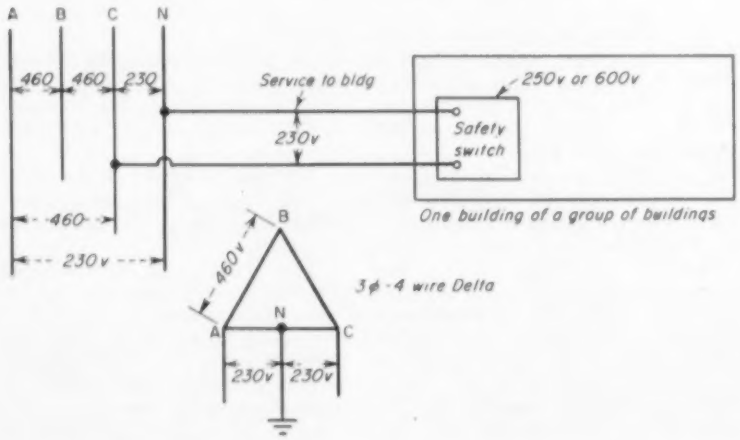
Q. *I would like amplification of NEC Official Interpretation No. 418, page 195 of EC&M, September, 1955. This says that an additional "set" of service entrance conductors "cannot" be installed between the meter enclosure and the service entrance equipment when additional current-carrying capacity is required. If the additional conductors comply with Section 3105, would not the old and new wiring together constitute a single "set" of service entrance conductors and be acceptable? Service conductors in multiple have been approved for new work so I assume Interpretation No. 418 was intended to be limited to the enlarging of old services.*—A.R.K.

A. It is my opinion that conductors in multiple may be used on either old or new installations provided they are so installed to satisfy the provisions of Section 3105. This rule requires that the parallel conductors be of sizes 1/0 to 500 MCM inclusive, of the same length; the same circular-mil area and of the same type of insulation. On a new installation all of these requirements may be easily satisfied but on an old installation it would be necessary to replace the old conductors unless the insulation used on the new set of conductors was the same as the insulation on the existing set of conductors. On an existing installation I see no conflict with this interpretation, when additional current capacity is obtained by running conductors in multiple between the meter enclosure and the service entrance equipment. We have not added an additional set of service entrance conductors. We have obtained the additional capacity desired by applying the recognition of conductors in multiple. This method produces the same result as that obtained if the old conductors were removed and replaced by a new set of larger conductors. In either case there would be only one set of service entrance conductors between the meter and the service equipment.—B.A.McD.

Voltage Rating—Feeder Switch

Q. *In the illustration shown, would a 250-volt or 600-volt safety switch be required?*—F.D.

A. It is evident from the illustration that the building served is one of a group of buildings that are connected to a master service. Since the voltage of the feeder serving this building is limited to 230 volts, a 250-volt rated switch is all that would be required.—B.A.McD.



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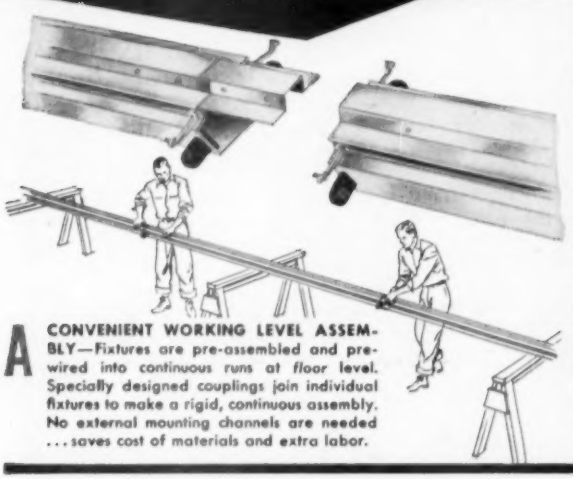

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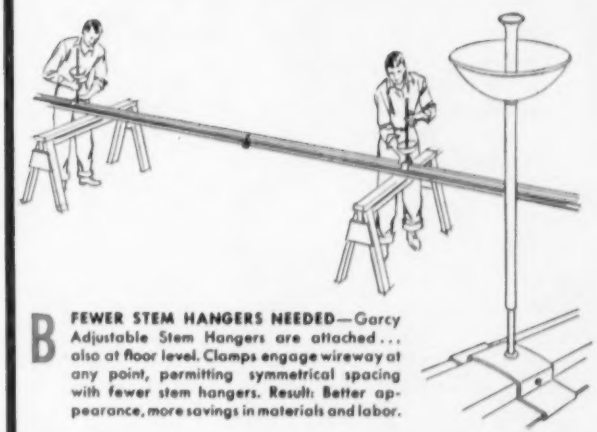

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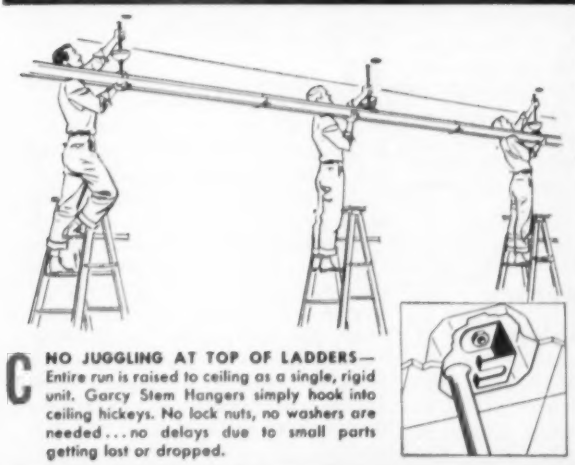

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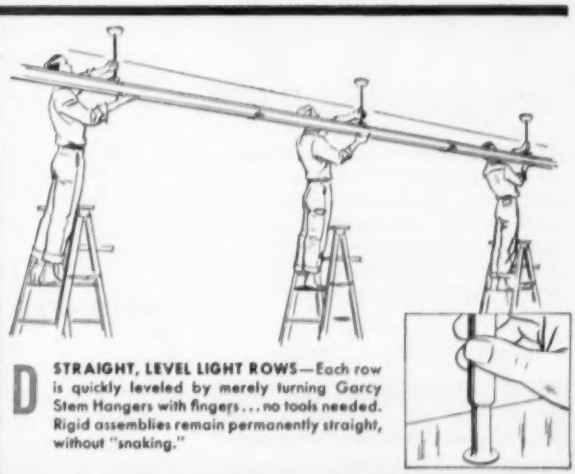

D STRAIGHT, LEVEL LIGHT ROWS—Each row is quickly leveled by merely turning Garcy Stem Hangers with fingers . . . no tools needed. Rigid assemblies remain permanently straight, without "snaking."

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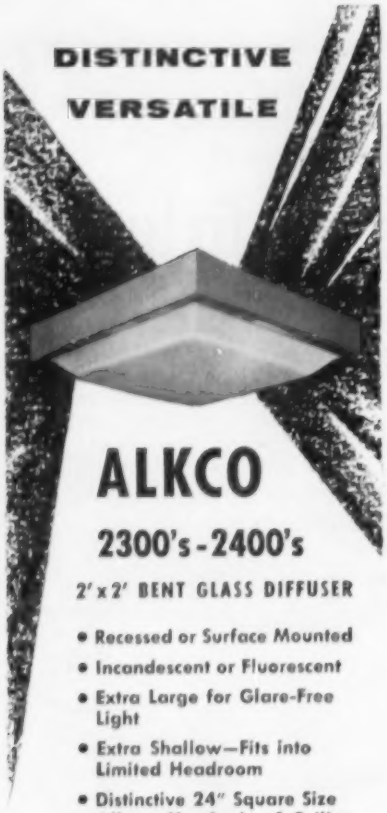

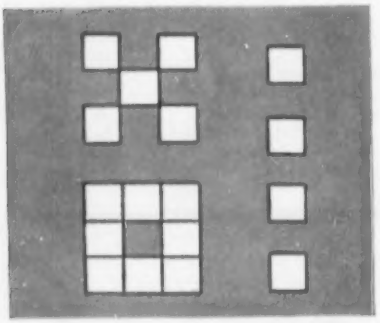

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Determining Hazardous Locations

Q. *Would the canning room in a lacquer factory, which is properly cut off from the balance of the plant be considered a Class 1, Group D location even though tests made with an explosion meter indicated the vapors present constituted less than 10% of those necessary to reach the lower limits of the explosive level of those vapors?*—R.K.

A. The determination of whether or not a room or area should be considered as a Class 1 Group D Division 1 location can be made only after a careful study of existing conditions and a thorough knowledge of the problems involved. The use of an explosion meter which takes air samples for individual momentary readings can prove to be most disasterous even though the instruments are properly calibrated and in perfect working order due to the fact the taking of such samples is only a momentary affair and will not give a true picture of conditions as they might exist over days, weeks or months. In any operation or process involving the use of volatile flammable liquids having flash points lower than the normal ambient temperature of the room or area in which these flammable liquids are exposed it can be expected to have combustible vapor-air mixtures present at some time or other unless the ventilation of that room or area is such that accumulations of these vapors is impossible. Therefore the only type of sampling instrument which could be relied upon would be one of the recording type which was operated continuously for at least a week or more during that time of year when the highest room temperatures existed and even then such tests would have to be taken in the most likely locations.—G.R.

Continuous Loading

Q. *In the November issue of EC&M, "Questions on the Code", a single phase, 3-wire, 120/240-volt lighting panel with 17,000-watt continuous load and maximum demand was assumed. In calculating the rating of the conductors feeding this panel, 17,000 was divided by 240, obtaining approximately 70 amps. In accordance with the first paragraphs of both Sections 2116 and 2203 NEC, why isn't a factor of 1.25 further applied to obtain the feeder rating?*—H.P.M.

A. If you will note, many of the questions asked us are far from complete in both information supplied and in the queries that are given to us. An attempt is made to keep the answers simple and within the requirements of the Code. A complete answer to every question asked to cover every Code contingency compatible with each of these queries would in many cases require a diacussion far beyond the scope of this column.

It is true that the Code requires a 25% factor as covered in the first paragraph, second sentence of Section 2116. From the information furnished I assumed that this panel would be used on a system supplying lighting and small appliances, which in toto would give a demand of 17,000 watts. Some diversity and therefore a demand factor would be applied to such loading.

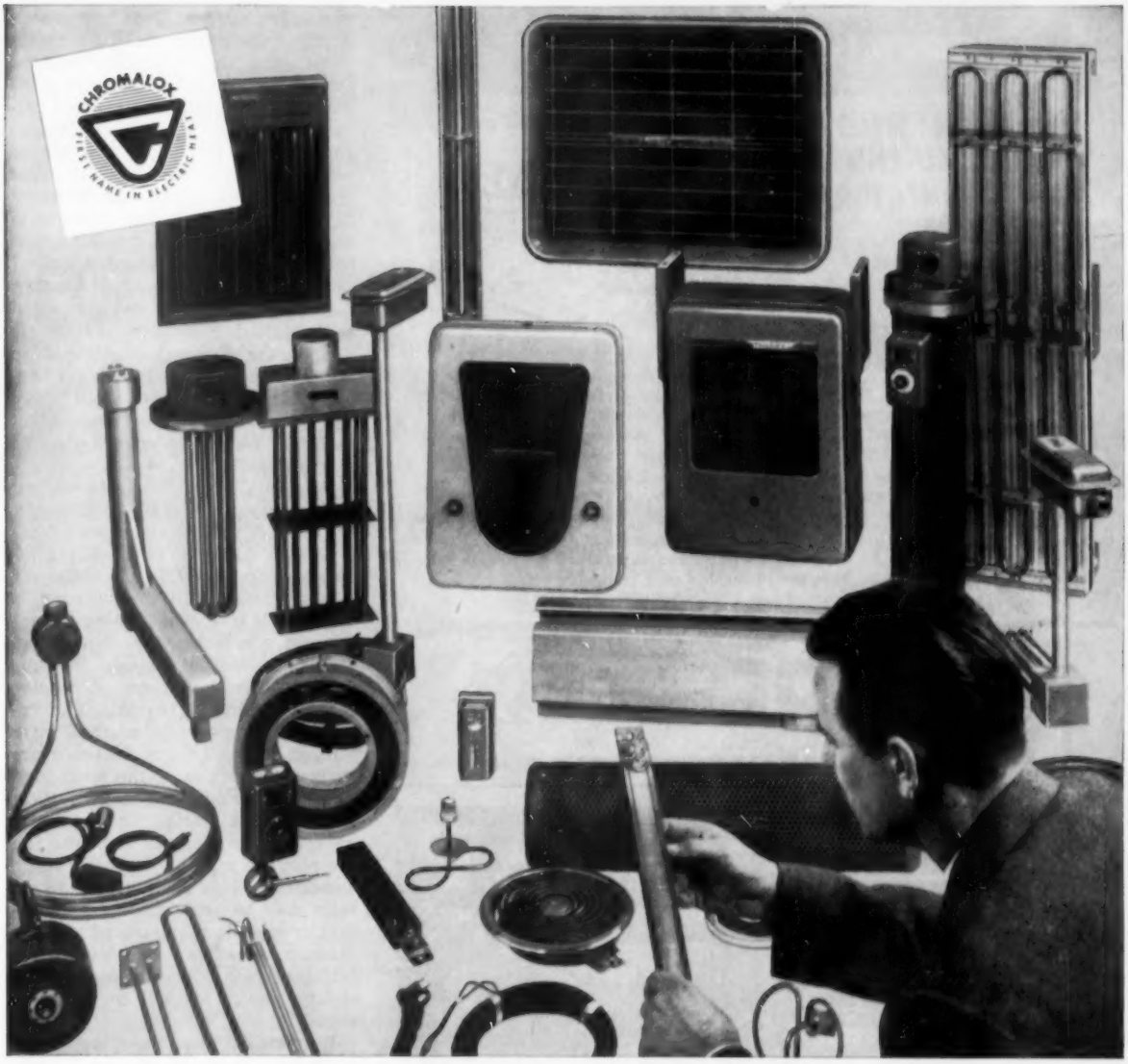
In actual design where all factors are known, it is generally accepted as good practice to incorporate this 1.25 factor in the branch circuit capacities and also in the feeder capacities. However, it will be found that many jobs which are being designed today are far beyond the requirements of the Code minimum and for this reason great care must be taken in applying additional load factors which may tend to increase conductor sizes far beyond the practical possible usage for the system involved.—B.Z.S.

Transformers—Class 2 Circuits

Q. *Most transformers for use in Class 2 signalling circuits are listed in the Underwriters' Laboratories Electrical Equipment List, under "Transformers, Power" with a note on use in Class 2 systems.*

I do not believe that this means that the transformers listed under "Transformers—Bell-Ringing" should not be used on Class 2 systems. However, under the heading "Rating", the currents and voltages for these bell-ringing transformers do not agree with those listed in Section 7281 of the Code.—C.P.S.

A. According to the Underwriters' Laboratories listing, bell-ringing transformers are designed to supply current to electric bells and other signaling de-



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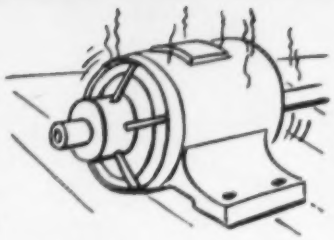

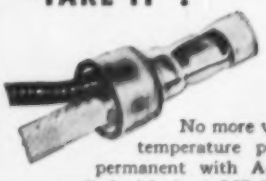

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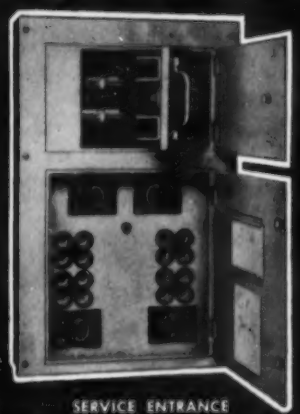

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vices. Their design is such that the secondary current does not exceed 6 amps under short-circuit conditions, and the secondary voltage does not exceed 30 volts under open-circuit conditions. The above wording indicates that such transformers are limited to the use of serving circuits to bells and other signaling devices and that their use to serve remote control circuits is questionable. I do not believe that this implication is intended since I note the listings under this heading include use which is not concerned with signaling devices. As an example, the General Electric type RT-1 transformer, which is designed to furnish low-voltage power for the operation of remote control relays is listed under bell-ringing transformers.

Section 7281 of the Code sets up limitations for Class 2 systems on the basis of voltage and amps as follows: 15 volts—5 amps, 15 to 30 volts—3 amps, 30 to 60 volts—1½ amps. These limitations appear to indicate that a bell-ringing transformer, which is rated 6 amps at 30 volts, could not be used for supplying Class 2 systems. I do not believe however that this was intended. It appears to me that these limitations apply only to the overcurrent protection of the secondary circuit. In lieu of this protection transformers having energy-limiting characteristics and approved for the purpose may be used. In other words the Class 2 circuit up to 60 volts may be protected by overcurrent devices or approved transformers. Section 7283 covers the rating of such transformers and restricts their output to 100-volt amps.

In view of the foregoing, I do not believe there is any conflict between the requirements of the Code and U. L. It appears to me that any bell transformer whose rated output does not exceed 100-volt amps could be used to serve a Class 2 circuit provided it was approved for the use intended. The case of the G. E. Type RT-1 transformer is an example which appears to support this opinion.—B.A.McD.

Service Conductors

Q. *We are installing a new service in a building consisting of parallel 500,000 circular mil conductors. May we terminate the 3½-in. conduits through which these conductors are pulled directly above enclosed switchgear if we bush the ends of these conduits and*

enter the switchgear through porcelain inserts having individual openings for each conductor? We will, of course, bond the service raceways directly with the enclosed switchgear using a No. 0 conductor as the ground wire. Will such an installation comply with the Code? —R.R.G.

A. No, such an installation will not be in compliance with the Code as Section 2339 states that "If conduit, electrical metallic tubing, or service cable is used for service conductors, the inner end shall enter a terminal box or cabinet, or be made up directly to an equivalent fitting, enclosing all live metal parts except that if the service disconnecting means is mounted on a switchboard having exposed bus bars on the back, the raceway may be equipped with a bushing which shall be of the insulating type unless lead-covered conductors are used."

Therefore, inasmuch as the installation you are planning does not use an open type switchboard, this section would require that the raceway be continuous to the enclosed switchgear. If you are having trouble in pulling conductors, this may be facilitated through the use of a pull box which could be nippled directly to the switch gear with the other end attached to the conduits containing the service conductors.

We also wish to call your attention to the fact that Section 2571 of the Code will require bonding jumpers about any pull box used in a run of service raceway.—G.R.

Conduit Fill— TW Conductors

Q. *Does the Code permit using three No. 8 TW wire in ½ in. and ¾ in. conduit? Also, is this increased wire size permitted with all sizes of TW wire? If so, why don't wire tables show this?*—F.F.

A. Section 3466 of the Code covers the number of conductors that are permitted in a conduit. On new work when all of the conductors are of the same size Tables 4, 5 and 9 of Chapter 10 applies. For rewiring in existing conduits, the allowable fill may be determined from Tables 11 and 12 of Chapter 10 using the dimensions from Table 13 of wire actually used. Reference to Table No. 11 further clarifies this rewiring provision

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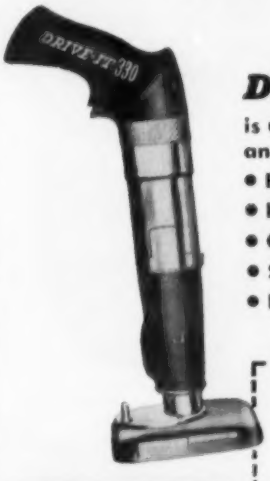

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with the following note: "For rewiring existing raceways for increased load where it is impracticable to increase the size of raceway due to structural conditions." Official Interpretation No. 286 further clarifies the intent of this provision by advising that it applies to concealed raceways.

Applying the above Code provisions we find on a new installation that a maximum of three No. 12 TW conductors may be installed in a ½ in. conduit as covered by Table No. 4. On rewiring however, as recognized above, Table No. 11 may be used. This table recognizes a 50% conduit fill when three or more conductors are involved. Table No. 12 shows that the square inch area of a ½-in. conduit is .30. 50% of this area .15 may be used by the conductors. According to Table No. 13, the area of a No. 8 TW conductor is .0408 sq in. and three of them have an area of .1224 sq in. Since this area is less than .15 sq in. the three No. 8 TW conductors could be installed in ½-in. conduit.

In the case of the ¾-in. conduit as many as four No. 10 TW conductors are permitted by Table No. 4 for new work in a ¾-in. conduit. When rewiring is involved the 50% conduit fill prevails and we have the following:

¾-in. conduit sq in. area .53. 50% .265 sq in. area of No. 6 TW is .0819. Three No. 6 equals .2457 sq in.

This increase in wire size applies to any size of TW conductors and also other types of insulation. Table No. 4 shows conduit fills based approximately on a 40% conduit fill. For rewiring existing raceways however this fill, as shown by Table No. 11, is increased to approximately 50%, and any type of conductor that may take advantage of this extra fill would be recognized for such use by the Code. The important consideration to remember, however, is the distinction between new work and rewiring existing raceways.—B.A.McD.

Protection for Transformer Conductors

Q. *This is in regards to the answer to the transformer problem in the November issue of EC&M. You suggest a 60-amp switch and 50-amp overcurrent devices. From looking at the diagram I would assume the conductors from the load side of the switch to the transformer and from the trans-*

former to the panel would exceed 5 ft.

I have searched the NEC, and our own city electrical code, and no where in either code can I find a section permitting the overfusing of conductors to a transformer.

The No. 8 conductors are fused at 50 amps and by applying the 2 to 1 transformer ratio the No. 4 conductors are fused at 100 amps. Thus No. 6 wires are required to the primary and No. 1 conductors to the secondary would be required when fused at 50 amps.

Where conductors are permitted to be overfused as in Section 6312 (b) it is definitely spelled out that conductors can be overfused. Therefore, if there is a section permitting the overfusing of transformer conductors, would you please send me this information?—J.A.J.

A. If you study Section 4513 you will note that as applied to secondary ties, paragraph b, spells out in detail that the overcurrent protection may be as high as 250% of the rated secondary current of the transformers. It should be noted that the other paragraphs of this section do not require the tie conductors to be more than 133 percent of the rated secondary current of the largest transformer.

Section 4512 permits the 250% rating or setting for any other transformer. I'll admit that this section does not spell out in so many words that the conductors need not be larger than the rated primary or secondary currents of the transformer but it has been generally accepted as good practice. It will be necessary to have conductors large enough for the system involved. Thus if the secondary or primary windings are connected in a "wye" system, the primary or secondary currents will be the same as the line currents and all leads may be based on these values. However, for a delta system, the line currents will be the vectorial sum of the phase currents, so that conductors will have to have a minimum capacity of at least 1.73 times the individual transformer rated currents — this is assuming of course, that all the transformers in the bank are of similar characteristics and have equal ratings.

You will find that many installations are made where these leads used for the interconnections of the transformer terminals are of a capacity less than the rated currents of the transformers. In general, these connections require very short leads, are exposed and there-

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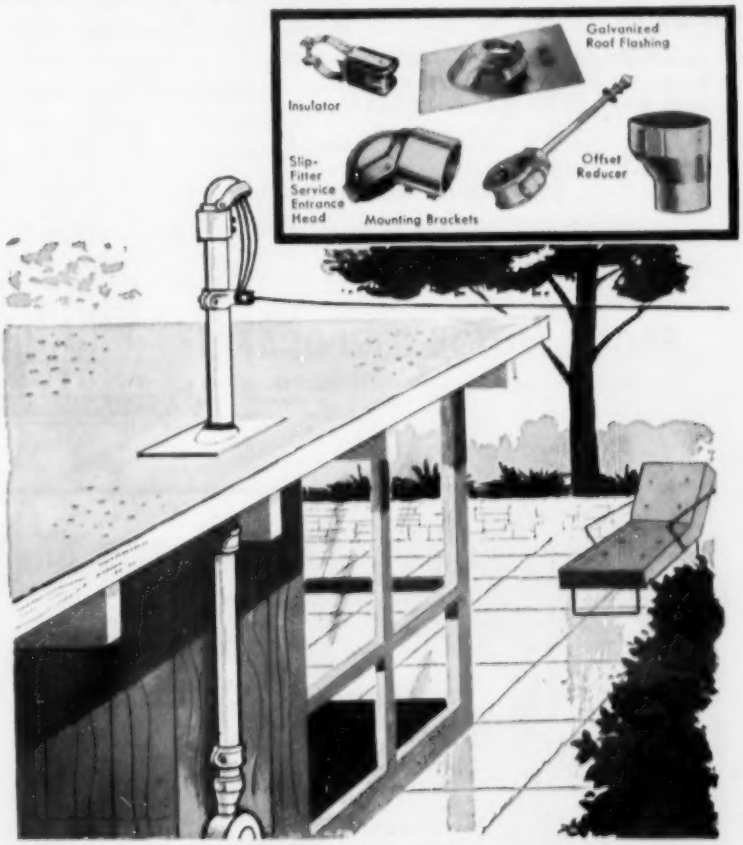

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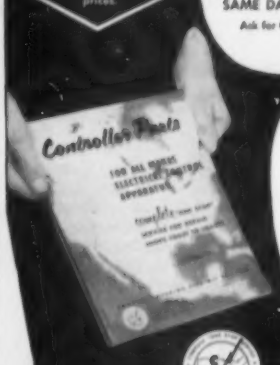

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fore have excellent operating conditions for heat radiation. The slightly higher impedance of these smaller leads sometimes accrues as an asset in that it tends to keep the short circuit currents down to values commensurate with the interrupting capacity of the overcurrent equipment being used in the circuit. —B.Z.S.

Fustats—Low and High Ambients

Q. *This concerns the installation of overcurrent protection in cold locations. We are installing a lighting panel in an unheated building where the temperature could reach minus 25 degrees Fahr. The branch circuit conductors are No. 14 TW with an allowable current carrying capacity of 15 amps at 86 degrees Fahr. We plan on protecting these circuits with 15-amp Fustats which in the summertime would provide protection. However, when the temperature goes down to 20 below the fuse, being a thermal element, would not trip at 15 amps but a considerably higher value. In the Code there is a table that gives a derating to the carrying capacity of wire for increases in temperature, but nowhere can I find where an increase in capacity is allowed for decreases in temperature. Thus at the low temperatures it appears that the conductors would not be protected and dangerous overloads are liable to exist. Would it be necessary to change the size of the uses in the winter in order to comply with the Code?*

This same problem arose recently when we installed a 200-amp service using 3/0 RH-RW in a location that was exposed to cold temperatures. In this case the 200-amp fuse would require a current of very much more than 200 amps to blow it on continuous overloads and therefore the wire would not be protected. It seems as though the wire size would have to be increased if the same size fuse is to be used the year around. My problem concerns how much of an increase is required. Would appreciate it if you would give me an example.—F.D.

A. I am unable to locate in the Code or the listing of Underwriters' Laboratories any provisions which concerns the correct rating of a Fustat which may be used in very high or low ambient temperatures, and to my knowledge there is no Official Interpretation

concerning this particular question.

As noted in your question, Table No. 1, Chapter 10 recognizes the fact that an insulated conductor when used in an ambient temperature exceeding 86 degrees F cannot carry its rated current capacity without injuring its insulation and provides correction factors to compensate this variable condition of use. It does not however recognize the increased current-carrying capacity of a conductor when used in a room temperature below 86 degrees F. During the past year however a proposal was presented to Panel 6 of the Electrical Committee which requested that an underground direct burial cable be recognized as operating in an ambient temperature below 86F and that a proportional increase in current-carrying capacity be recognized. This proposal was denied on the basis that such cables are brought into the building and subjected to the prevailing room temperatures.

The correction factors for room temperatures over 86F first appeared in the 1940 Code and shortly afterwards on March 1, 1941 the following O.I. No. 195, was issued.

"Question: What is the intent with respect to correction factor for room temperatures over 30 degrees C 86 F, of Tables 1 and 2?

"Finding: The intent is that room temperatures shall be assumed to be 30 degrees C (86F) without respect to geographic location, for all interior wiring except in parts of premises (regardless of geographic location) which are recognized as exposed to high artificial heat such as rooms containing boilers, bake ovens, commercial kitchens, enameling ovens, grain dryers, metal heating furnaces, etc., or in industrial plants near ovens or other equipment producing high ambient temperatures."

To me, this interpretation infers that a building up in Alaska, regardless of outside or inside actual temperatures is considered to be heated to a temperature of 86 F and the correction factors apply only when artificial processes involved with the type of occupancy produce high ambient temperatures. It is also noticeable that the correction factors apply only to room temperatures and therefore would not concern conductors installed outdoors, geographically located where temperatures range from below zero to above 100 F.

The only place in the Code that I can locate where any recognition is given to the effect of temperature on the operation of an overcurrent

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device is covered for circuit breakers under Section 2403-C. This section advises through a fine print note as follows: The effect of temperature on the operation of thermally controlled circuit breakers should be taken into consideration in the application of such circuit breakers when they are subjected to extremely low or high temperatures. While this provision is only a recommendation, some circuit breaker manufacturers have recognized the significance involved and provided for same. As an example, one manufacturer has incorporated in its circuit breaker design an arrangement whereby the ambient temperature may be compensated from 0 degrees F to 150 F. In connection with heater units used in conjunction with motor controllers, the General Electric Company advises that all Trumbull heaters and relays are based on a 40 degree centigrade ambient and such devices will carry approximately 1% more current for each degree (centigrade) less than 40 degrees centigrade ambient, also, 1% less current for each degree (centigrade) more than 40 degrees centigrade.

Insofar as Fustats are concerned the Bussman Manufacturing Company advises as follows: "In abnormal cases, such as where Fustat is located in a place where a high temperature prevails—or where motor is started frequently or reversed quickly—or where motor is direct connected or chain driven to a machine that cannot be brought up to speed quickly—a Fustat larger than recommended above may be used. In this case, the Fustat provides only short circuit protection."

I believe the foregoing comment indicates that, insofar as the Code is concerned, there is very little recognition given to correction factors for thermal overcurrent devices which operate in either high or low ambient temperatures. As a result, reliable manufacturers should be consulted with respect to their product and their recommendations for the abnormal use presented by your question. In view of the many variables and considerations involved, I am not in a position to advise you on the correct procedure to follow. I am however directing a copy of our correspondence to Mr. Segall, Chairman of Panel No. 6, Mr. Lloyd, Chairman of Panel No. 4 and also the Bussman Mfg. Company with the thought that possibly the Code should recognize the factors you have presented and the manufacturer may be able to recommend the correct procedure to follow in the case presented.—B.A.McD.

Sections 2116 and 2203

Q. *I am concerned with a problem and would appreciate an answer to the following code question, as stated:*

The following air conditioning equipment has been installed and is fed by three No. 4 TW conductors at 230 volts, 3-phase:

1—10-hp compressor
1—7½-hp compressor
1—3-hp fan
1—1½-hp pump

Using the same No. 4 feeder and a double-throw changeover switch, how much, to the nearest kw, electrical heating can be installed for winter use? Disregard power factor and efficiency of the heating equipment. Please note that any fan, or other auxiliary equipment will be supplied by a separate feeder.

Perhaps I am confusing the apparent contradiction between Sections 2116 and 2203h of the 1953 Code.—C.E.G.

A. It would seem you are somewhat confused as to the application of the 25% increase factor in the general heading of 2116.

The intent is to make sure that both the branch circuits and the feeders will not carry more than 80% load if the load is such as to be classed "a continuous load" as described in 2116. For example, suppose you plan to use a heating unit which would have a single current rating of 70 amps. In other words, when you threw the disconnect switch on, you would immediately energize the entire unit and cause 70 amps to flow. Now suppose further, this heater does not have any thermostatic controls and once it is put into use it would be used continuously for two, three, four, or more hours. In this case I would say the No. 4 feeders should be increased to have at least 70/.8 or 85 amps capacity, or to No. 4 Type RH or No. 2 Type R in conduit.

Now if the heater consists of several units with separate branch circuits, we may have a condition which will permit us to use the 70-amp feeders, for heaters rated in excess of 70 amps. Thus Section 2203h tells us we may in effect, overload the feeders as far as connected load is concerned, but "the conductors are of sufficient capacity of the load so determined". In other words, you may have say five heater units, each on a single branch circuit fed from these feeders. Suppose each heater unit is rated 20 amps, for example, for a total load

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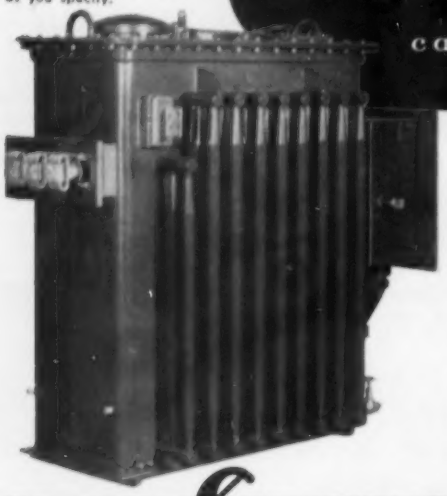

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just press the button!

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Engineering Representatives in Principal Cities

Wheelock CODE CALL SIGNAL
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of 100 amps feeder connected load. Suppose also each heater has a thermostatic control. Because of these controls we may be able to show the "authority enforcing the Code", that no one unit will be in operation for more than say a half hour or one hour continuously. The authority may then grant permission to use just a 20-amp branch circuit for each heater unit and permit full loading. From a practical standpoint you will have to go to a 30-amp branch circuit protective device since, in most cases, fuse equipment and circuit breakers will not carry full rated load even for such relative short periods of time. You could still use No. 12 wire, but most inspectors, would, I feel sure, require No. 10—even though you don't exceed the 50% overprotection—since the inspector would feel, and rightly so, that the 30-amp fuses or circuit breakers would be too great a temptation for overloading the No. 12 wires.

Furthermore, if you can show that, feederwise, the diversity is such that there will never be more than 70 amps maximum demand, the No. 4s may be approved for the 100-amp connected load. However, here again, we must be sure that the 70 amps will not be in circuit for more than say three hours (continuous loading ideas vary—some inspectors will say one hour is continuous and others will say five hours is continuous).

So you can see if you had a single heater unit I would say the largest unit you could use if the unit were subject to continuous loading, would be 80% of the 70 amps or 56 amps, or in 3 phase, 56 x 230 x 1.732 or 22.3 kva, approximately.

If the heater has a thermostat control and would not operate continuously, but rather intermittently so that the load would never be on continuously for more than an hour at one time, I would say you could use the full capacity of 70 amps, or 70 x 230 x 1.732 or 28 kva, approximately.

If several units with individual controls were used then there is no telling how much kva can be connected.—B.Z.S.

Bushings On EMT

Q. *I am finding many local inspectors who approve the use of EMT box connectors without using a bushing on the inside to protect the wire from any sharp surfaces. I cannot find anything in*

the Code to justify this practice.

Paragraph 3009—General Wiring Methods would cause a person to apply a bushing in all cases.

Paragraph 3736-b—applies to No. 4 and larger.

Paragraph 0468—Rigid Metal Conduit—has an "if" in it, but I had always associated this statement to apply to cast iron boxes where the design of the box was equal to a bushing in the protection of the insulation. L.E.M.

A. I do not believe that Section 3009 is concerned with the question since it is an exception to Section 3008. Section 3008 provides that a box or terminal fitting having a separately bushed hole for each conductor shall be used wherever a change is made from conduit, electrical metallic tubing, non-metallic sheathed cable, armored cable or Type MI cable and surface metal raceway wiring to open wiring or to concealed knob and tube work. Section 3009 is merely an exception to this provision which recognizes the use of a bushing in lieu of a box or terminal fitting and the bushing could be made of metal.

Section 3468 requires the use of a bushing when a conduit enters a box or other fitting for the protection of wires from abrasion.

This general provision applies to conduit and the bushing concerned is usually made of metal. Under Article 348 covering electrical metallic tubing there is no similar provision since the design of the box connector does not involve the use of a bushing.

Section 3736-b requires in addition to the protection afforded by the use of the metal bushing, insulation protection when the conductors are No. 4 or larger. While the heading of this section, "Insulation at Bushings," infers that the rule only applies when metal bushings are used, I personally believe that this provision would also apply to the fittings used with EMT. This rule is limited to No. 4 or larger conductors.

In view of the foregoing requirements, the Code does not provide for insulation protection at metal bushings when the conductors are smaller than No. 4. Several inspectors and engineers do not agree however that this minimum Code requirement adequately safeguards the hazard, especially when vibration and humidity are involved. As a result they either require or promote the use of insulating bushings or insulating inserts regardless of the size conductor used.—B.A.McD.

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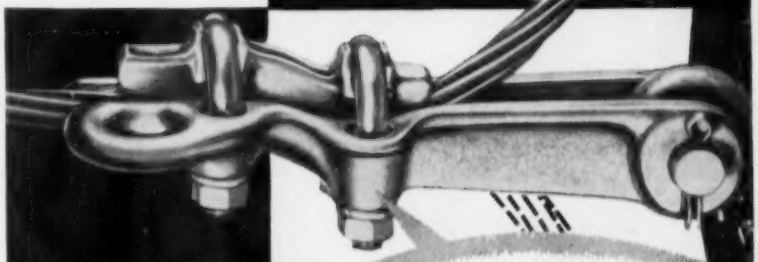

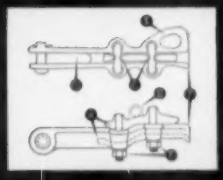

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They're built for long, trouble-free service. (A) The body and keeper are high strength cast #356 aluminum alloy, heat treated. (B) Conductor can be inserted through clamp without removal of nuts. (C) U-bolts peened to unit keeper to facilitate ease of hot-line work. This *one-piece* assembly of U-bolt and keeper distributes pressure over large area and prevents damage to cable. No liners are required. (D) "Lifting" eye optional for use in hot line work. (E) "Come-along" eye for ease of sagging cable. (F) Flared mouth protects cable from chafing and crystallization due to vibration. (G) Adequate length for conductor to clear insulator disc... cable can be extended either above or below.

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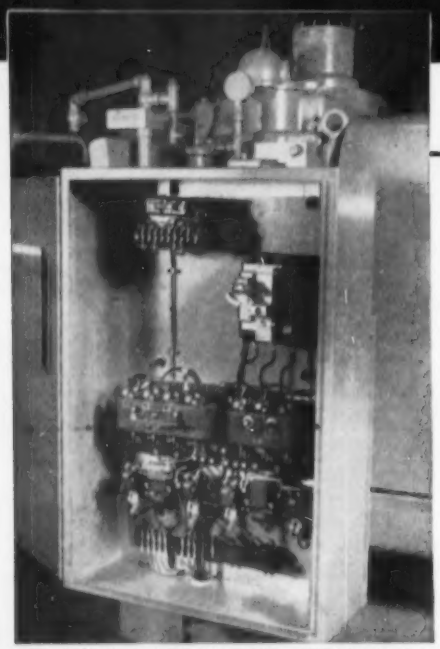

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In The News

"Live Better—Electrically" Launched With Nation-Wide Closed-Circuit Telecast

"Live Better—Electrically" is the theme of a national campaign now under way to promote the benefits of better living offered to homeowners through the use of electrical appliances and utilization devices. The program was launched on February 8, 1956, with a coast-to-coast closed-circuit telecast to an audience of 40,000 electrical trade allies. This telecast, the largest closed-circuit presentation in the history of television, was directed to electrical contractors, electrical wholesalers, consulting engineers, architects, bankers, builders, realtors, appliance dealers and appliance distributors. The program is under the direction of electric utility companies. All of the interested business and industry groups were told the plans and objectives of the program.

The "Live Better—Electrically" program has been developed to create demand among the public for electrical appliances and the home electrical wiring systems necessary to make possible the use of appliances. The objectives of the program are to equate "better living" with use of electrical appliances and thereby develop the vast residential market for electricity and electrical products. To these ends, a complete program of national advertising, publicity and educational activities has been developed to take the message of electrical living to the public on a large-scale, continuing basis. Local electric utilities will spark activities at the city and town level.

As the program is arranged, the electrical contractor stands to benefit greatly, along with the other business and industry groups. The electrical contractor can look forward to increased opportunities for home rewiring. This is a large and ever-expanding market. Homes—old and even new ones—are plagued by inadequate wiring. The 30- and 60-amp 2-wire service today represents a tremendous barrier to expansion of electrical living. This barrier must be knocked down to allow widespread application of the great variety of electrical appliances and devices now available to the consuming public. The "Live Better—Electrically" program depends upon elimination of the home wiring bottleneck and is therefore aimed at helping the electrical contractor sell "load-matched" wiring—the modern home wiring layout which will allow full, convenient use of electrical products. And of course, the program is designed to make electrical wiring a bigger part of new home construction, increasing the contractor's interest in this market and offering him more dollar volume of work.

Details of the overall campaign are many and varied. Beginning April 12, 1956, the first of a series of dramatic full-color, double-spread advertisements will appear in the nation's leading consumer magazines to promote the "Live Better—Electrically" concept to America's home-owning millions. The program theme will be beamed coast-to-coast on some of television's most impressive network programs.

ELECTRICAL INSPECTOR R. J. Niessuld, representing New York City office of Zurich Insurance Company, right, shows interest in cut-a-way motor being discussed by Tom Kearney of Wagner Electric at Plant Maintenance Show.

In addition, local and regional television and radio programs will carry promotion of the campaign, sponsored by electric utility companies and their trade allies. Other ads will be run in newspapers and in buses, streetcars, railroads and subways. A full-color, 72-page book, "New Step-by-Step Ideas to Help You Live Better—Electrically" tells the homeowner all about the wonders and benefits of electrical living.

One of the books made available as part of the program is a book on design and installation of home wiring systems, with information on selling. This book, entitled "How to Help Home Owners Live Better—Electrically", presents the new concept of "load-matched" wiring describing this as wiring matched to a load made up of existing electrical utilization devices plus an amount of spare capacity in service entrance conductors and equipment to accommodate an anticipated growth in electrical load. The book sets standards for design of branch circuiting and selection of the best service entrance arrangement for any condition of load. Flexibility of layout, use of load center panelboards and limited loading of circuits are some of the highlights of the approach. In sizing service entrance conductors, new application of demand factors is given. The use of 75% diversity factor for four or more fixed appliances is carefully reconsidered and a 100% factor is recommended when analysis of the conditions indicates probable simultaneous use of many fixed appliances. The book also covers modern circuit control techniques, wiring materials for home electrical systems and complete coverage of such utilization systems as lighting (indoor and outdoor), heating, air conditioning, ventilating and communications.

The "Load-Matched Wiring" book is available for 10 cents from local utility companies.

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Chicago Tallies Rewiring Score

Better wiring is on the march in the Chicago area. More home builders are putting adequate wiring in 100% of the houses they build for resale. More electrical contractors are climbing on the adequate wiring bandwagon. Thousands of homeowners are upgrading their services to 100-amp capacity. Apartment building owners are beginning to rehabilitate their outmoded electrical distribution systems. Industrial and commercial building managements are becoming electrical modernization conscious.

The facts were reported to some 200 local electrical industry representatives at the Chicago Electric Association's Third Annual Better Wiring Conference. Among those present were a substantial number of electrical contractors from the city and immediate suburbs. All took a searching look at the 1955 tally, noted the progress over the previous year, and left the meeting with a determination to make a better score in 1956. To date, the Chicago tally sheet looks like this.

Certification of new home wiring in 1955 was more than double that of 1954. The Chicago total stood at 3,878 last year, compared to only 71 at the end of 1953. Last year, 42 home builders offered adequate wiring in 100% of their houses built for resale; in 1954, the number was 28. Forty electrical contractors installed adequate wiring in 50 or more homes as of last year; in 1954, only 20 contractors had reached this mark. Builders and contractors were given certificates of commendation at the conference.

National Adequate Wiring Bureau Chairman Carl Bremicker reported that, nationally, AW certifications range from 8% to 33% of all new homes built (Chicago, last year, was 8.7%); that the 101 local AW Bureaus this year will cover about 50% of all residential meters in the U. S.; that 90% coverage is the goal over the next 5 years.

Almost one million dollars of rewiring business was done last year under the Commonwealth Edison company pay-as-you-go plan. Basically, this is a program to promote installation of 100-amp, 3-wire services in existing homes. If the homeowner has a 240-volt appliance to be connected, the utility pays about one-third of the service entrance cost; otherwise the customer pays the entire bill. In either case, the utility pays the electrical contractor and the customer pays the utility monthly installments along with the electric bill (EC&M, Feb. 1955, pg. 193). Last year, about 90 electrical contractors successfully bid for this work on a more or less fixed-price basis.

GLENN ZENGER, maintenance foreman for Bendix Aviation at Tuckhannock, Pa., considers a new twist being demonstrated by Denny Groves, sales manager for Pipemaster Tools, during Plant Maintenance Show at Philadelphia.

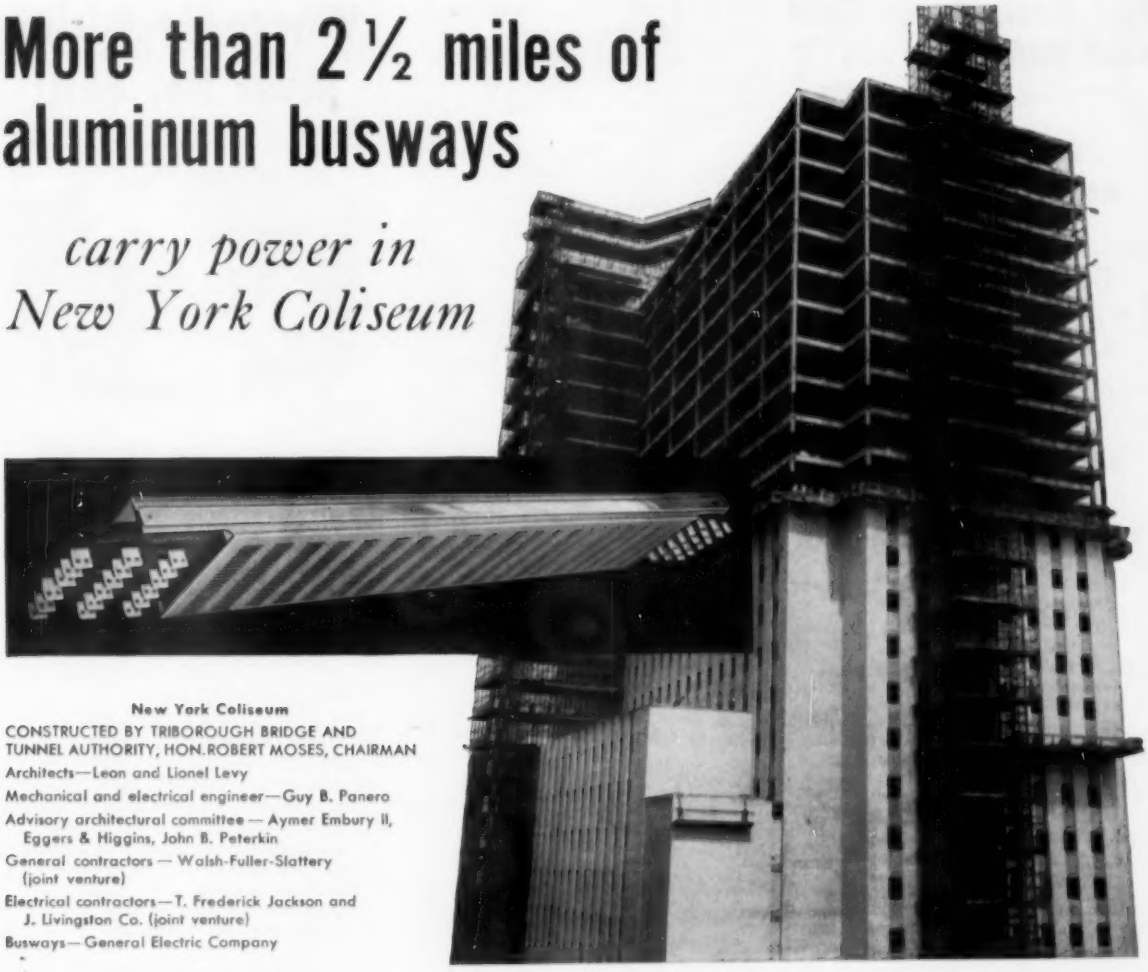
This year, Pierron revealed, the plan will include two No. 3 and one No. 5 RHW conductors in service entrance cable, an 8-circuit panel and 24 months instead of 12 months in which to pay. Customers can still include up to $100 in additional rewiring under the financing plan. Last year, 28% of the customers selected the finance plan, Pierron noted, and there were no collection problems on the wiring accounts. With increased costs this year, Pierron expects the installations (including extra wiring) to average about $150 compared to the $119 for 1955.

Biggest obstacle electrical contractors face in the residential rewiring market is the lack of electricians who can do or are willing to do this type of work, according to contractor Howard L. Zingraf, Sr. To get their share of this tremendous market and give customers the type of service they should expect, contractors will have to train the electricians, he warned.

Wiring modernization in apartment houses is a much more complicated and costly proposition. Contractor T. L. Hankins, president, Condo Electric Co., advised contractors to study modernization methods carefully and offer the owner his choice of several methods. Among these are: hot sequence

More than 2½ miles of aluminum busways

carry power in New York Coliseum



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Mechanical and electrical engineer—Guy B. Panero
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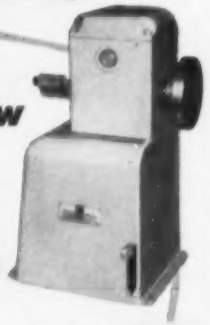

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* The lowest priced unit obtainable with comparable performance—with motor $225.00. F.O.B. Woodstock, Ill., state or local sales taxes extra. Prices apply in U.S.A. only.

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service; 480-volt risers and/or feeders to meter centers.

Should a rewiring job cost more than the owner can spend at the time, break the job down into these four major parts:

1. Service feeders and service equipment
2. Feeders to meter centers
3. New tenant meter and distribution facilities
4. Rewiring apartments

Determine the serious bottlenecks in the existing system and remedy that first with the other rewiring to come later, Hankins suggested.

Electrical modernization in the industrial and commercial fields offers a tremendous market potential to the electrical contractor, George Bard, president, Kelso-Burnett Electric Co., told the group. Concentration on this market will enable the contractor to: (1) preselect his prospects; (2) use his engineering and creative selling talents; (3) operate in a field of minimum competition; and (4) get a job at a fair price with a reasonable profit. Contractors must take the lead, he warned, since they are the only group who can tell the customer what the installed cost will be. Take advantage of every opportunity and available sales tools to sell your service, then be organized to follow through and perform, he advised.

To do a good wiring job, we have to exceed the minimum safety standards required by electrical codes, William P. Hogan, chief electrical inspector of the City of Chicago, told the assembled group. Adequate wiring promotion, beginning as far back as the 1927 Red Seal Wiring Standards, appears to have definitely stimulated Code progress, Hogan believes. Many local codes still lag behind modern standards in their minimum service requirements, he noted. Hogan is firmly convinced that 100-amp services must be required in all single-family dwellings over 900 or 1,000 sq ft of living area; and that definite requirements will have to be made in future codes for air conditioning receptacles.

An outline of the Electric Association's Better Wiring Educational program was given by A. J. Massey, district sales manager, The Wiremold Company. H. C. Moses, Jr., Association president, urged more active cooperation between electrical industry groups to give the public the rewiring it requires. B. H. Boatner, Westinghouse Electric Supply Co., Chicago, chairmanned the all-day session.

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Model 15 HQ 15,000 Watts.

SIZES AND MODELS FOR EVERY NEED

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- **Water-cooled: 10,000 to 50,000 watts**

Available unhoused or with steel housing as shown.

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Describes scores of standby models with complete engineering specifications and information on installation.

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Electric Space Heating Developments Disclosed

More accurate methods of relating degree-days to actual heat energy requirements; effects of non-heating appliances on required heating capacity; incandescence as a means of air purification; and observations on present and future electric heating control methods were reported by industry experts at the Winter General Meeting of the American Institute of Electrical Engineers in New York City on February 1.

W. R. New, Tennessee Valley Authority, presented results of studies of electrical consumption in several extensive electrically heated housing developments in the TVA area. The study showed that (1) use of the conventional 65F degree-day base for the calculation of heating capacities gives too low a value for the heating energy requirements during the midwinter months, requiring for greater accuracy a temperature base varying monthly between 65F and 75F; (2) the so-called non-heating appliance load identified with today's electrical living is believed to be 10% to 20% of the season's heating requirements and as such justifies consideration in the determination of installed heating capacity; (3) electrically heated homes use some 400 kw-hrs more energy per consumer per month during the non-heating season than those without electric heating, indicating the great potential of electric heating as a sales force for the use of electricity.

J. C. Beckett, Wesix Electric Heater Co., spoke on the effects of heat as a means of air purification, followed by a discussion of trends in electric space heating controls. Carefully controlled tests by Mr. Beckett and Prof. C. E. Clifton of Stanford University have shown that the extreme heat of incandescence is very effective in destroying organisms ordinarily existing in the home. While extensive summer ventilation keeps the home relatively free of organism build-ups, the concentration is ten times as great during the winter, when windows are kept closed. The tests have shown that use of the incandescent type of electric heater can reduce the winter concentration to summer proportions and realize fresh air despite the tight house.

On the subject of electric heat controls, Mr. Beckett emphasized the convenience of a master central

ONE MAN— ONE TOOL— ONE MINUTE—

—and 6 fastening studs are securely set in concrete or steel!

GIVE A MAN the Remington Stud Driver and that fastening job's practically done! This compact tool sets up to 6 studs per minute . . . anchors fixtures to concrete or steel with a squeeze of the trigger. It sets both ¼" and ⅜" diameter studs arrow-straight — with no pre-drilling required.

Change-over from one stud size to the other is quick and easy. Operator can change barrels in 90 seconds, *right on the job*. There's no time lost in going from medium- to heavy-duty work — no need for a second tool.

There are 40 different styles and sizes of Remington Studs to choose from and a variety of 22 and 32 caliber power loads. With studs and cartridges in pocket, Remington Stud Driver in hand — you're ready for *every* stud-fastening job. Find out how the tool saves time and money in fastening wood sleepers, furring strips, metal window frames and other fixtures by mailing coupon below.

Remington

DU PONT

STUD DRIVER

Industrial Sales Division E.C.M. 3
Remington Arms Company, Inc.
Bridgeport 2, Conn.

Please send me your free booklet which shows how I can speed the job and save with the Remington Stud Driver.

Name_____ Position_____

Firm_____

Address_____

City_____ State_____

WIN THE BID-INSURE THE PROFITS

with

Intermatic
TIME SWITCHES

Low bid usually gets the job, so you need a time switch that's low in cost—that's Intermatic. And to *guarantee your profit* on every job, you need a time switch that's designed for lightning-fast installation, and completely dependable, so complaints and call backs won't kill your profit—that's Intermatic.

HERE'S WHY IT'S TIME TO SWITCH TO INTERMATIC

Faster Installation
- Press one lever to remove *entire* mechanism
- Convenient knockouts, mounting holes
- 31 cubic inches of wiring and working room

Better Performance
- Snap-action, heavy duty contacts for minimum arcing and pitting
- E-Z see dial reads easily, sets in a second

Longer Life
- Powered by famous International heavy duty timing motor
- All models approved by Underwriters' Laboratories

A COMPLETE LINE, FOR EVERY TIMING NEED

1 to 96 on and off operations
5 min. to 23 hours
daily or skipping days
Wired-in or plug-in

Most models available with UL approved raintight case.

WRITE FOR CATALOG 36B1 for full information and prices

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2624 W. Washington Blvd.
Chicago 12, Illinois

control in addition to the individual room controls, with an outdoor anticipating thermostat to cut down the capacity of connected heating equipment during the milder parts of the heating season. He expressed the view that, considering the number of controls involved, keeping equipment costs down is of paramount importance; and therefore for the average application a line-voltage thermostat can be made sufficiently sensitive for accurate use.

Further comments on the subject of control furnished by J. E. Goff, Ceilheat, Inc., included explanation of the need for more attention to radiant temperature conditions as well as simple air temperatures, because of the relative slowness with which air temperatures change. A 3-degree drop in air temperature may very well be accompanied by a 7-degree drop in mean radiant temperature, with an accompanying feeling of discomfort to occupants. This emphasizes the importance of short cycling of the thermostat, keeping air temperatures between ½ and 1 degree to avoid allowing the mean radiant temperature to go through wide changes. Although artificial cycling of the thermostat by anticipation does a good job of short cycling, a better sense of radiant temperature by the thermostat is desirable, he said.

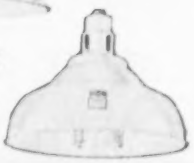
B. L. Boyd, Jr., Commercial Controls Corp., saw no possibility of foreseeable electric heating saturation becoming objectionable to utilities, particularly since the upswing in the use of heat-producing appliances is constantly narrowing the differential between summer air conditioning load requirements and those for winter heating. Utility transformers, currently capable of handling 100% more load in winter than in summer, will have this advantage narrowed down to somewhere around 40% when higher-power-factor air conditioners predominate the summer load; but Mr. Boyd sees as an alleviating factor the possibility of a seasonal interchange of power between a utility having a high winter peak with one having a high summer peak.

C. F. Kreiser, Edwin L. Wiegand Co., saw a trend toward increased use of baseboard heaters due to their ability to both counteract infiltration of outside air and alleviate cold floor conditions. He observed that, although heating "added-on" rooms represents a considerable portion of the market today, each such installation is a

AT NO EXTRA COST

SLOTTED-NECK construction is an original **ABOLITE** development. It costs you no more than ordinary reflectors.

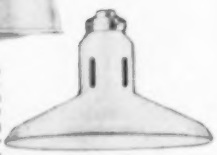
ABOLITE SLOTTED-NECK lighting fixtures provide longer lamp life because lamps operate at cooler temperatures.



You can have ABOLITE All-White

SLOTTED-NECK ABOLITE fixtures stay cleaner longer. Dust and grime is forced through ventilator slots by continuous convection currents.

ALL-WHITE finish (inside and outside) gives you a modern, efficient appearing lighting fixture which compliments contemporary architecture.



slotted-neck reflectors

Actual tests show that **ABOLITE ALL-WHITE SLOTTED-NECK** lighting fixtures give 36% more illumination than ordinary reflectors after 12 weeks continuous use. In addition, modern **ABOLITE** fixtures provide 7% more uplight, and a 1000 watt bulb operates 40°F cooler in a **SLOTTED-NECK ABOLITE** reflector.

All these features mean more and better light with an absolute minimum of maintenance . . . and *at no extra cost!*

ABOLITE *Lighting* DIVISION
THE JONES METAL PRODUCTS CO.
WEST LAFAYETTE, OHIO

stepping stone toward going all-electric.

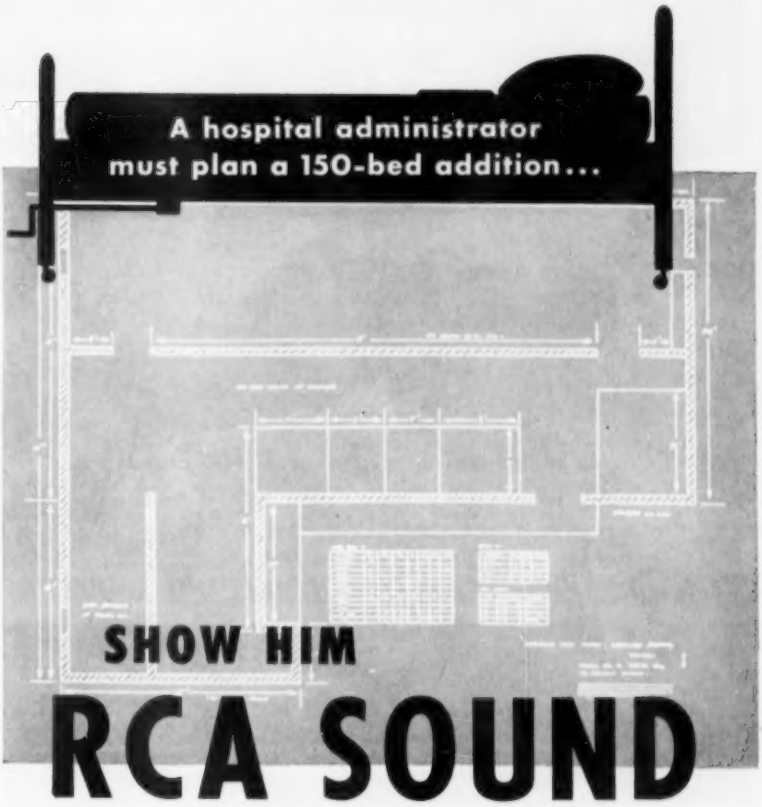
In conclusion, J. E. Woodward, Union Electric Co. of Missouri, described that utility's struggle with increasing air conditioning loads since 1952, changing the picture during that period from one of a high-power-factor winter peak to one of a low-power-factor summer peak. He stated that Union Electric is constantly seeking compensating winter loads and predicted that northern utilities would experience similar growing pains in the near future.

The program was sponsored by the committee on domestic and commercial applications, under the chairmanship of Buford H. Martin, Tennessee Valley Authority.

Electrical Industry Conference Studies Home Wiring Market

Last month, the Business Development Committee of the National Electrical Contractors Association sponsored an Electrical Industry Conference in Washington, D. C. At this meeting, the electrical industry's approach to the vast market for residential modernization was discussed and analyzed. The 166 representatives of electric utilities, manufacturers, distributors, retailers, labor and electrical contractors studied the problems which confront the industry in meeting the market demands for which almost $10,000,000 will be spent on advertising and promotion. The supply of skilled labor and the availability of electrical contractors were two of the most important considerations.

It was estimated that there are 20,000,000 homes in America requiring an average of $250 in electrical modernization work—a total of $5 billion in home rewiring business. The total of all electrical contracting business for last year was $4 billion. Thus the potential market for residential modernization is about 20% larger than the total of electrical construction done in any one year. The potentially serious labor supply problem represented by this situation is clear. If any large part of the modernization work were to be taken on in one year, the requirements for journeymen electricians could not be met. And even if the work is spread over the next 20 years, there would be a need for 12,500 mechanics, in addition to the present force of



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RCA moves you several jumps ahead of the competition when you bid on sound system specs for any type construction. The reason: RCA has *the* name that's known for dependability and quality in electronics. And this is quality that costs no more.

You sell all the advantages of RCA engineering . . . the only sound-system engineering backed by the world-wide reputation and precision-manufacturing skill of the Radio Corporation of America. Performance of every RCA component year after year *shows* the difference. They're flexible components, too . . . a complete, intermatched audio line. And you can sell RCA service, nationwide service with replacement parts ready any time, should they be necessary.

Your RCA Engineered Sound Distributor will help you in every way as you plan a sound installation. He's ready to aid you in custom-designing for individual requirements. He stocks the components you need to do any job fast. Get started rolling up RCA Sound System business *now* . . . with "Sound in Industry," the 12-page RCA booklet that tells the whole RCA quality story. There's a lot in it for you if you mail the coupon today!

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Please send me—at no obligation—the RCA booklet "Sound in Industry."

Name _____ Title _____
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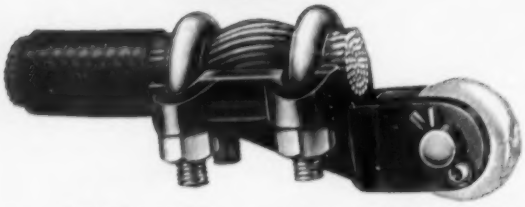
"EFFICIENCY" Cable Strain Clamps

without Strain or Damage



. . . Withstands direct pull of 17,000 pounds

Efficiency Cable Strain Clamps lock cable safely and securely without possible strain or damage. "H" construction of clamps and high ridge across center of cable prevents cable from slipping. Takes cable from 1/0 to 1,500,000 c. m. Three clamp sizes cover all cable sizes. Furnished with eye or clevis, for AC or DC Service.

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"EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION

Efficiency ELECTRIC AND MANUFACTURING CO.

MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT AND WIRE CABLE SUSPENSION

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HYDRAULIC PRESS for solidifying aluminum terminal lugs to cable is demonstrated by G. E. Nelson of Thomas & Betts to Oscar Sandstrom of Minnesota-Ontario Paper Co., International Falls, Minn., at Plant Maintenance Show.

125,000 union electricians, for each of those years.

The many promotional campaigns for residential electrical modernization are directed from every segment of the electrical industry. The long range goal of the "Live Better —Electrically" program is to raise the standard of living by increasing the use of electricity from a present 2500 kwhr annually to 4500 kwhr.

In discussions, contractors reported on their experiences with residential modernization. Some found it highly profitable and even off-setting to losses in highly competitive bid work. Others found it undesirable. There was general agreement that house modernization requires a better mechanic with a sense of public relations.

There was considerable discussion over which of the two basic problems should be tackled first; one, the skilled housewireman shortage; or the shortage of electrical contractors willing to adapt themselves to this work.

The IBEW, through President Freeman, pledged intensive interest in this work and promised steps would be initiated to provide more and better mechanics skilled in house rewiring. The NECA Research Committee, whose members attended the session, started work immediately on making studies of successful contractor operations, developing management aids and guides in this field and disseminating this information to the industry.

Use... BELL "JUMBO" OVERSIZE WALL PLATES

"JUMBO" SIZE 3½" x 5½" Full Bevel

to cover those RAGGED BOX OPENINGS!

Standardize on Jumbo size plates. Saves time and money on new installations or replacements. Eliminates need for expensive re-plastering or repairing of walls, saves electricians' costly call-backs.

Available in "15" different finishes:
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No. 140 1-Gang Duplex Receptacle
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(State finish when ordering)

Specify BELL "JUMBO"

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K&H Solderless Terminal LUGS — A SIZE and TYPE for every need! — K&H Solderless CONNECTORS

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DATES AHEAD

National Electrical Manufacturers Assn.—Edgewater Beach Hotel, Chicago, Ill., March 12-16.

Southeastern Electrical Exchange — Annual meeting, Boca Raton Hotel & Club, Boca Raton, Fla., March 12-14.

Edison Electric Institute—22nd Annual Sales Conference, Edgewater Beach Hotel, Chicago, Ill., March 26-29.

Electrical Industry Show—8th Biennial Show, Shrine Exposition Hall, Los Angeles, Calif., April 5-7.

Illuminating Engineering Society—Regional Conferences: **Southern**—Birmingham, Ala., Apr 5-7; **Southwestern**—Hilton Hotel, Fort Worth, Texas, April 8-10; **South Pacific Coast**—San Francisco, Cal., April 15-17; **Pacific Northwest**—Davenport Hotel, Spokane, Wash., April 19-21; **Inter-Mountain**—Utah Hotel, Salt Lake City, Utah, April 26-28; **Great Lakes**—Toledo, Ohio, May 7-8; **Milwestern**—Indianapolis, Ind., May 10-11; **Canadian**—Chateau Frontenac, Quebec, P. Q., Canada, May 17-18; and **East Central**—Shoreham Hotel, Washington, D. C., May 24-25.

Electrical Estimating Institute—Two-day conference and workshop of estimating for industrial, commercial and residential work; also modernization and rehabilitation projects, University of Wisconsin, Madison, Wis., April 9-10.

Western Pa. Safety Engineering Conference and Exhibit—Hotel William Penn, Pittsburgh, Pa., April 10-12.

National Association of Lighting Maintenance Contractors—Annual conference, Hershey Hotel, Hershey, Pa., April 16-18.

International Association of Electrical Inspectors—State Chapter Meetings; Pensacola, Fla., April 6-7; **Kenturck Chapter**—Bowling Green, Ky., May 26-27; **Mississippi Chapter**—Edwards Hotel, Jackson, Miss., Feb. 20-21; **Arizona Chapter** — Tucson, Mar. 10, also Show Low, Ariz., May 12; **North Carolina Chapter** — Carolina Hotel, Raleigh, N. C., April 10-11; **South Carolina Chapter** — Columbia Hotel, Columbia, S. C., April 16-17; **Alabama Chapter**—Whitley Hotel, Montgomery, Ala., April 19-20; **Georgia Chapter** — Ware Hotel, Waycross, Ga., April 23-24; **North Louisiana and Texas Chapters** — Alexandria, La., May 4-5; **Ontario Chapter**—LaSalle Hotel, Kingston, Ontario, Canada, June 2; **Virginia Chapter**—Roanoke Hotel, Roanoke, Va., June 25-26; **Southern California Chapter** — San Diego, Mar. 28, Long Beach, May 23 and Santa Monica, July 25; **Southern Section**—Conrad Hilton Hotel, Dallas, Texas, October 22-24.

California International Home Show & Builders Market Week—Oakland Exposition Bldg., Oakland, Calif., April 21-29.

JUST ONE TERMINAL...

for FIVE wire sizes... #16 thru #8

A single size Buchanan Termend® Lug terminates all wire sizes from #16 thru #8 stranded and #16 thru #10 solid. Different tongue styles and various stud hole sizes are available.

The Termend® Lugs are quickly installed with the Buchanan C-24 pres-SURE-tool with exclusive 4-way crimp,—same tool also splices from 2 #18's thru 3 #8's or 2 #6's with only two sizes of Buchanan Splice Caps.

FAST SURE LOW INSTALLED COST

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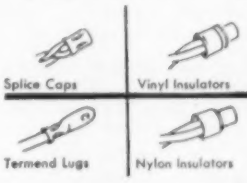

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ELECTRICAL PRODUCTS CORPORATION
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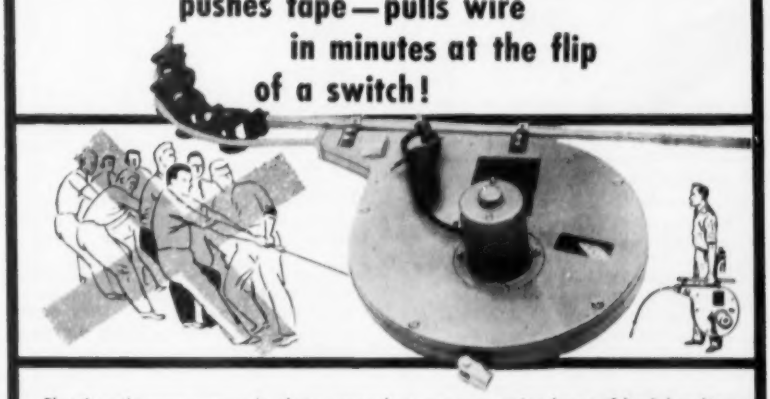
THE BARTH CABLE PULLER
pushes tape—pulls wire in minutes at the flip of a switch!



Electric maintenance crews in plants everywhere are now saving hours of back breaking labor pulling in service runs to all kinds of machines with easy-to-set-up Barth Cable Pullers. Make a Barth Cable Puller standard equipment for your electric maintenance crews.

Attached direct to conduit. Weighs only 70 lbs., 115 V-AC/DC. Easily moved from job to job.

Distributed nationally by Westinghouse Electric Supply, G. E. Electric Supply, Graybar Electric Co. and other leading distributors.

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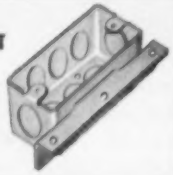
Preferred by more contractors today, because ARROLET's products answer modern installation problems, saving time and costs.

HANDY BOX with MOUNTING BRACKET

1⅛" deep.—Made with new type angle bracket for quick, accurate installations.

Cat. No. HB-10-BA



3¼" ROUND BOX

¾" deep.—With or without stud for use in ceiling or wall construction where very shallow box is needed.

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NON-GANGABLE SWITCH BOX

1½" deep.—For thin wall or concrete block construction. Available with ½" K.O.'s for use with conduit. May be nailed on or can be had with several types of brackets.

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ARROVAL FITTINGS

Oval type, threaded, for standard rigid conduit. In ½", ¾" and 1". Covers and gaskets available in various sizes and types.

ARROLET products are available in an unlimited number of combinations, types, sizes and wiring capacities to fit any job specification.

When you have an installation problem not covered by our standard line, our engineers will design special units to your specifications.

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Electrical Manufacturers' Representatives Association of Michigan, Inc.—Ninth Electrical Exhibit, Detroit Artillery Armory, Eight Mile Road, Detroit, Mich., April 24-26.

International Home Building Exposition—New York Coliseum, New York City, May 12-20.

National Industrial Service Association, Inc.—Annual convention Bellevue Stratford Hotel, Philadelphia, Pa., May 13-17.

Pacific Coast Electrical Association, Inc.—Annual convention, Las Vegas, Nev., May 14-16.

Design Engineering Show—Convention Hall, Philadelphia, Pa., May 14-17.

Southeastern International Industrial Exposition—Lakewood Park, Atlanta, Ga., May 25.

Edison Electric Institute—24th annual convention, Atlantic City, N. J., June 4-7.

National Fire Protection Association—60th anniversary meeting, Hotel Statler, Boston, Mass., June 4-8.

National Association of Electrical Distributors—48th annual convention, Ambassador-Chelsea Hotels, Atlantic City, N. J., Week of June 10.

New York State Association of Electrical Contractors and Dealers, Inc.—Annual convention, Saranac Inn, Saranac Inn, N. Y., June 24-29.

International Association of Electrical Inspectors—Section meetings: **Northwestern Section**—Newhouse Hotel, Salt Lake City, Utah, Sept. 10-12; **Southwestern Section**—Hotel and city to be announced, Sept. 17-19; **Western Section**—Statler Hotel, St. Louis, Mo., Sept. 24-26; **Canadian Section**—King Hotel, Toronto, Ontario, Canada, Oct. 12-13; **Eastern Section**—Wentworth - by - the - Sea, Portsmouth, N. H., Oct. 15-17; **Southern Section**—Statler - Hilton Hotel, Dallas, Texas, Oct. 22-24.

Illuminating Engineering Society—National Technical Conference, Hotel Statler, Boston, Mass., Sept. 17-21.

Instrument Society of America—Eleventh Annual Instrument Automation Conference and Exhibit, New York Coliseum, New York City, September 17-21.

National Electrical Contractors Assn. 55th Anniversary convention and Second National Electrical Exposition, Sheraton - Palace Hotel, San Francisco, Calif., September 23-29.

National Electronics Conference—Hotel Sherman, Chicago, Ill., October 1-3.

International Association of Electrical Leagues—21st annual conference, Sheraton - Cadillac Hotel, Detroit, Mich., October 3-6.

National Electrical Manufacturers Association—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 12-16.

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Conduit running thread is furnished in convenient 3' lengths in three finishes: raw black, electroplated and hot-dipped galvanized.

Your orders can be shipped promptly from the factory or from one of ten strategically located warehouses.

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It doesn't Cost... it Pays to use...

HELWIG CARBON BRUSHES

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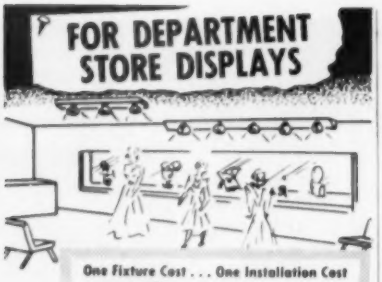

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ROTO-STRIP
C.S.A. APPROVED Pat. Pend.

Illustration shows 5-light corner-mounted and 3-light ceiling-mounted Roto Strips highlighting displays with beams of light from all angles. Result: better looking merchandise . . . more sales.

This complete shallow unit (available for surface, corner or recessed mounting) has built-in recessed roto sockets that swing 90° in all directions through a complete 360° circle . . . and stay put at any angle. Available in stock sizes of 2'-3'-5' and 8' lengths.

Surely Roto-Strip has a place in your plans.

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MANUFACTURERS OF LIGHTING FIXTURES INCLUDING

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NEO-RAY PRODUCTS, Inc.
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LOW PRICE SMALL SIZE

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"MINOR" MEGOHMER

PINT SIZE INSULATION TESTER

500 VOLTS DC GENERATOR

Range 0-50 megohms. True Ohmmeter, independent of generator speed. Furnished with genuine leather carrying case, 6' test leads, 50 megographs.

Write for Bulletin No. 450

HERMAN H. STICHT CO., INC.
27 PARK PLACE NEW YORK 7, N. Y.

Among the Manufacturers

Headquarters Announcements

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Walter T. Saveland, Jr., service and renewal parts group head.

Clark Controller Co., Cleveland, Ohio—E. R. Jung, vice president in charge of the new marketing division; Robert Whitehill, general sales manager; W. R. Heckman, manager of industrial sales; Clarence Atkins, manager of the renewal parts division.

Metalcraft Products Co. has taken over manufacture and marketing of the Planned Lighting Line of fluorescent fixtures formerly produced by Gill Glass & Fixture Co. Both firms are located in Philadelphia, Pa.

General Electric Co., Nela Park, Cleveland, Ohio—E. R. Maize, Jr., retail sales grocery specialist for the Large Lamp Dept.

Signal Engineering & Mfg. Co., has changed its name to Wheelock Signals, Inc. The firm is now located at Long Branch, N. J.

Sylvania Electric Products Inc., Wheeling, W. Va.—Lloyd Durfee, Jr., commercial lighting engineer.

Square D Co., Electric Controller & Mfg. Div., Cleveland, Ohio—Asa H. Myles, chief engineer and member of the operating committee.

General Electric Co., Plainville, Conn.—Robert C. Wilson, manager-marketing for the Distribution Assemblies Dept.

Duro-Test Corp., North Bergen, N. J.—G. R. McGruther, director of sales.

Irvington Varnish & Insulator Div. of Minnesota Mining & Mfg. Co., Irvington, N. J.—Roy J. Gavin, vice president and general manager.

Mississippi Aluminum Corp., Gulfport, Miss. — H. F. Devens, manager.

Simplet Electric Co., Sycamore, Ill., will hence forth be known as Simplet Fittings Div., Ideal Industries Inc.

Kellogg Switchboard & Supply Co., Chicago, Ill.—J. T. Robertson, assistant sales manager.

General Electric Co., Waterford, N. Y.—Walter J. Dugan, manager-sales development in the marketing section of the Silicone Products Dept.

Garden City Plating & Mfg. Co., Chicago, Ill.—Robert E. Kelly, national sales manager.

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No. 999 Faster Than Ever!

Instant Die Change
Spin Torque Chucking
High Speed Threading

Toledo Spin Torque Chuck For Faster Production

Quick change features of the TOLEDO No. 999 Pipe Threading Machine have proved real time and money savers on hundreds of jobs. Now . . . with the addition of the Toledo Spin Torque Chuck even faster production is provided. Instant changeover from cutting to threading . . . Spin Torque Chucking—a quick spin and pipe up to 2" is locked in the chuck—no wrenches, no rocking, socking or hammering. Bench type or portable floor models, full ½ H.P. motor powers heavy gear train drive, finger tip controls. Remember—if it bears the TOLEDO label you know it's a dependable product. See it at your suppliers or write for complete information. The Toledo Pipe Threading Machine Co., 1445 Summit Street, Toledo 4, Ohio.

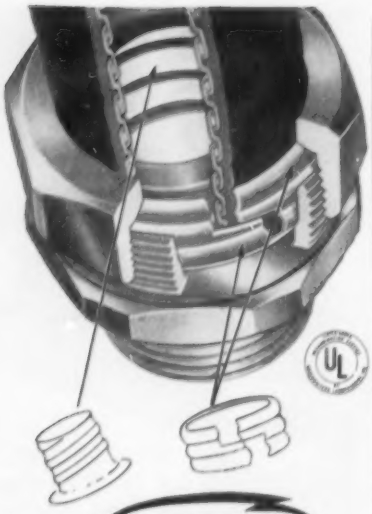
THE TOLEDO PIPE THREADING MACHINE COMPANY

1445 Summit St. TOLEDO 4, OHIO

BUILDERS OF THE WORLD'S FINEST PIPE TOOLS

TOLEDO

PIPE THREADERS • PIPE WRENCHES • PIPE MACHINES



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VAP-OIL-TITE CONNECTORS

For Liquid-Tight Flexible Metal Conduit

The only completely REUSABLE connector!

PROVIDES PERMANENT WIRING PROTECTION

● Easy-to-apply... Ideal-Simplet Vap-Oil-Tite Connectors adjust quickly to conduit size variations. They positively seal out vapor, oil, water or dust. Grounding bushing assures positive ground . . . flange covers raw ends of conduit . . . and you can actually see that the bushing seats all the way!

Exposed parts all *non-corrosive* metal, Vap-Oil-Tite Connectors have positive ground, tapered threads, and tremendous gripping power through serrations on split ring. Underwriters' Laboratories, Inc. approved with 200 lb. pull test. Fit both EF and UA conduit. Write for further details and prices.

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IDEAL INDUSTRIES, INC.

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Day-Brite Lighting, Inc., St. Louis, Mo.—J. F. Whitehead, Jr., O. C. Klingsick, W. L. Rehfeld and Gordon Scherck are new members of the board of directors.

Westinghouse Electric Corp., Staunton, Va.—R. D. Hartsig, manager of contract sales for the air conditioning division.

Graybar Electric Co., New York, N. Y.—George J. Kennedy, general commercial sales manager.

Progress Mfg. Co., Inc., Philadelphia, Pa.—Samuel Stein, vice president.

Appleton Electric Co., Chicago, Ill.—I. W. Strong, executive vice president; E. V. Aldridge, assistant vice president-sales; W. H. Schroeder, treasurer.

Lewyt Air Conditioner Corp., Brooklyn, N. Y.—Bernard Grill, chief product engineer.

Spang-Chalfant Div. of National Supply Co., Pittsburgh, Pa.—R. P. Abraham, conduit sales manager.

General Electric Co., Plainville, Conn.—John A. Kelly, marketing administrative specialist and J. E. Van Effen, manager—commercial service for the Trumbull Components Dept.

Ideal Industries, Inc., Sycamore, Ill.—Marc A. Buettell, executive vice president and general manager.

Ramset Fastening System, Cleveland, Ohio—W. R. Kelty, Jr., manager.

W. E. Moore & Co., Pittsburgh, Pa., and its four affiliates have been acquired by McGraw Electric Co.

Weston Electrical Instrument Corp., Newark, N. J.—R. A. Schlegel, manager of industrial product sales.

O. K. Tool Company, Inc., Milford, N. H.—L. C. Gaunt, sales manager.

Vitro Corporation of America, New York, N. Y.—T. M. Lumly, member of the board of directors.

Regional Appointments

NEW ENGLAND

Miller Company: E. S. Coe, eastern regional sales manager, headquarters in Meriden, Conn.

Sprague Electric Co.: W. F. Arnold, Sr., manager of new Boston sales office at 313 Washington St., Newton, Mass.

Fasco Industries, Inc.: Meaney-O'Connell-Millerick, Inc. of Boston are New England representatives for fans and ventilators.

Warner Brake & Clutch Co.: John F. Gibney, sales representative for Maine, New Hampshire, Rhode Island and northeastern Massachusetts; headquarters in Canton, Mass.

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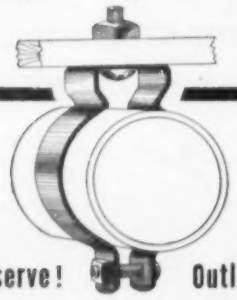

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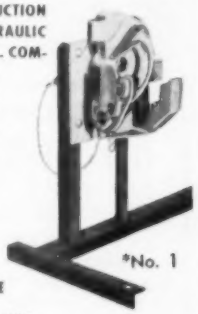

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MIDDLE ATLANTIC

Toledo Pipe Threading Machine Co.: W. L. Gahman, regional sales manager for New England and Middle Atlantic States, working out of New York City.

Tork Clock Co., Inc.: Dick Batlan, New York representative.

National Electric Products Co.: Donald F. Dimock, Pittsburgh district sales manager.

The New York City office of National Electric has been moved to 545 Madison Ave. and sales in the city will be managed by Frank Brady.

Kellogg Switchboard & Supply Co.: W. C. Hopper, northeastern division manager; home office in Clifton, N. J.

Warner Brake & Clutch Co.: J. B. Scudder, sales representative working from offices in Madison, N. J.

Litecraft Mfg. Corp. and Finland House Lighting Corp.: Monroe Meirowitz, L. I. district manager.

Moe Light Div., Thomas Industries Inc.: Sam Levaur, eastern division sales manager.

Line Material Co.: W. K. Oberschelp, field engineer for eastern Pennsylvania, offices in Harrisburg.

Thor Power Tool Co.: J. P. Stine, East Coast zone manager with headquarters in Newark, N. J.

SOUTH ATLANTIC

Acme Electric Corp.: James K. Brokaw, sales representative for transformers in Tennessee, Georgia and northern Alabama. Home office in Nashville.

Sylvania Electric Products Inc.: Charles C. Beyer, district sales manager for lighting products in Charlotte, N. C. district comprising the Carolinas, Kentucky, Virginia and Tennessee.

Carrier Corp.: H. E. Miller, Washington, D. C. branch manager of the Unitary Equipment Division.

Pittsburgh Standard Conduit Co.: James P. Quick's Washington, D. C. territory has been extended to include Eastern Shore counties of Maryland and four counties in the Baltimore area.

National Electric Products Corp.: John R. Patton, Atlanta, Ga. district sales manager.

Moe Light Div., Thomas Industries Inc.: V. L. Wrye, southeastern division sales manager. Headquarters in Greensboro, N. C.

Thor Power Tool Co.: R. J. Burch, southeastern zone manager, offices in Birmingham, Ala.

Line Material Co.: R. W. Kelly, field engineer for Alabama sales, working out of Birmingham office.

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House Lighting Corp.: G. Boyd Farthing of Baltimore, sales representative for Maryland, Delaware, Virginia and Washington, D. C.

EAST CENTRAL

Toledo Pipe Threading Machine Co.: Blake Wilson and R. W. Warnke, regional sales managers for north central and east north central areas.

Electro Dynamic Div., General Dynamics Corp.: Lloyd Van Buskirk, Jr., Detroit district manager.

Garden City Plating & Mfg. Co.: Avron L. Simon, manager of Chicago sales district; F. P. Schram and Reginald Lyman, sales representatives for Indiana and Cleveland area.

Moe Light Div., Thomas Industries Inc.: Roy Vershure, Great Lakes divisional sales manager.

WEST CENTRAL

Line Material Co.: Ralph L. Hamer, central division manager, directing sales in Illinois, Kansas, Iowa, Nebraska and Missouri from offices in North Kansas City. W. E. Bracey has been transferred to manager of the southwest division, offices in Dallas.

Beaver Pipe Tool, Inc.: Gordon Burke, Kansas City district manager covering Missouri, Kansas, Nebraska and Iowa.

O. Z. Electrical Mfg. Co.: Harlan J. Weisler, representative for Kansas, Missouri and lower Illinois, offices in St. Louis.

Toledo Pipe Threading Machine Co.: H. R. Strouse, southeastern regional sales manager covering Texas, Oklahoma, Louisiana and Mississippi.

Moe Light Div., Thomas Industries Inc.: E. A. Lea, midwestern divisional sales manager, headquarters in Kansas City.

WEST

KSM Products, Inc.: F. G. Kern, district engineer for the Stud Welding Div., located at new office at 1615 Polk St., San Francisco, Calif.

Toledo Pipe Threading Machine Co.: Marvin Cox, western regional sales manager.

Moe Light Div., Thomas Industries Inc.: A. O. Grotenhuis, divisional sales manager for the Pacific Coast and Mountain States, headquarters in Los Angeles.

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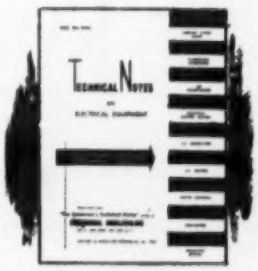

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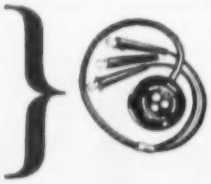

KNOPP INC.

Founded in 1928 by Otto A. Knopp under the name of Electrical Facilities Inc.

4232 Holden St. Oakland 8, Calif.

CUT-BACKS IN CONDUIT RISERS

[FROM PAGE 85]

It is evident that to adequately rewire this building for today's electrical living, regardless of the service or feeder system adopted, new risers are necessary. Older buildings with such inadequate raceway facilities can be excused, since even optimistic appraisals of electrical growth made 10 to 15 years ago failed to come near the record utilization actually attained. However, there is no excuse for 2- to 5-year-old buildings requiring rewiring, as many do today; nor will there be an excuse 5 or 10 years from now for those built today. The phenomenal growth of electrical appliances and the emergence of air conditioning and electric heating from the luxury class, with nothing but rapid growth predicted for the future, earmark all wiring installations which take care of only today's minimum requirements as shortsightedness at best.

The small savings effected by conduit cut-backs as compared with the cost of complete new risers can be shown using the above example. Carrying a 1½-in. conduit all the way to the sixth floor for, say, 15 risers would have involved an extra expenditure at the time of construction of around $500. Today, rewiring costs using existing risers would be in the order of $15,000 for such a building, as compared with around $35,000 for replacing the raceway as well as the wiring.

The problem involved consists of educating the individuals making the decisions that $500 saved today at the expense of the electrical system is false economy when a $20,000 difference in rewiring costs may be just around the corner. The electrical contractor, too, has an obligation. In addition to direct promotion and organizational participation, he can bring the problem to the attention of the parties concerned by taking the future into account in his estimates. By submitting a *second* figure in his bid to cover work and materials in excess of specifications needed to insure future raceway adequacy—together with an explanation of the factors involved—he can protect his position with respect to his bid on the original specs and at the same time fulfill his obligations as an electrical man to promote the cause of adequacy.

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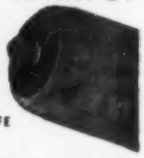

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LOW-COST PROGRAMMED LIGHTING

[FROM PAGE 90]

in the basement storage room immediately under the panel and is operated by two normally open momentary-contact switches adjacent to the panel. Wiring this unit was simplified by connecting only the downlights to the B-phase circuits at the top of the panel, then installing the dimmer ahead of the B-phase bus of the panel. A padlocked single-pole safety switch on the B-phase feeder protects the dimmer from tampering.

The pattern of light programming varies according to the type of service but the degree of flexibility afforded by this system is indicated by a few of the effects employed. For example, during services, lantern downlights are kept dim and are brought up only for group singing and readings from the Prayer Book. This device also signals the congregation when to rise and when to be seated. During sermons from the pulpit and readings at the lectern, the general lighting in the choir and sanctuary is extinguished and the spot over either location is turned on; the solitary figure of the pastor standing under this spot against the background of the light-flooded vaulting and the altar cross below its downlight presents an impressive sight. Labels on the panel indicate which circuits are used in each lighting arrangement.

This element of the electrical modernization of St. John's, which included installation of a new service and distribution, and rewiring and relighting of the basement sunday school room, kitchen and choir room, plus new outside lanterns at the entrances, acquires particular significance as an example of effective results obtained within a limited budget by imaginative planning and active coordination of the design and installation functions.

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Model 689-1F comes complete with operating instructions, test leads and LEATHER CARRYING CASE.

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Advertising In This Issue

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• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE

For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

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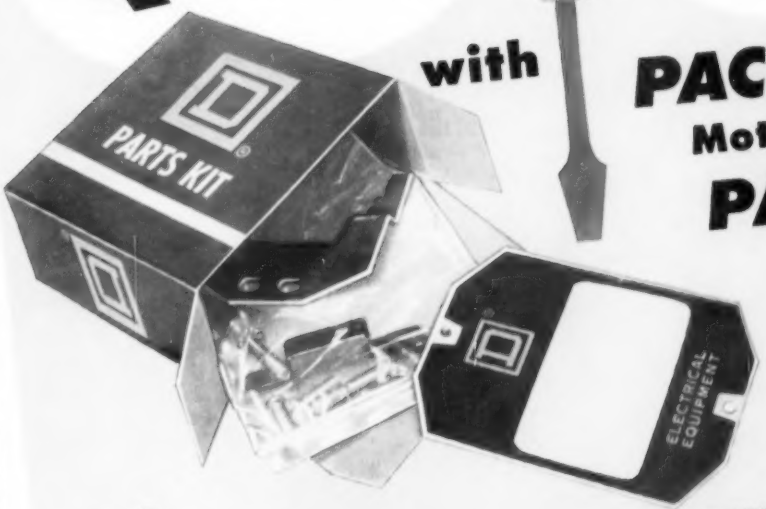

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Conveniently packaged parts can be installed using only a screw driver and without disturbing any wiring.

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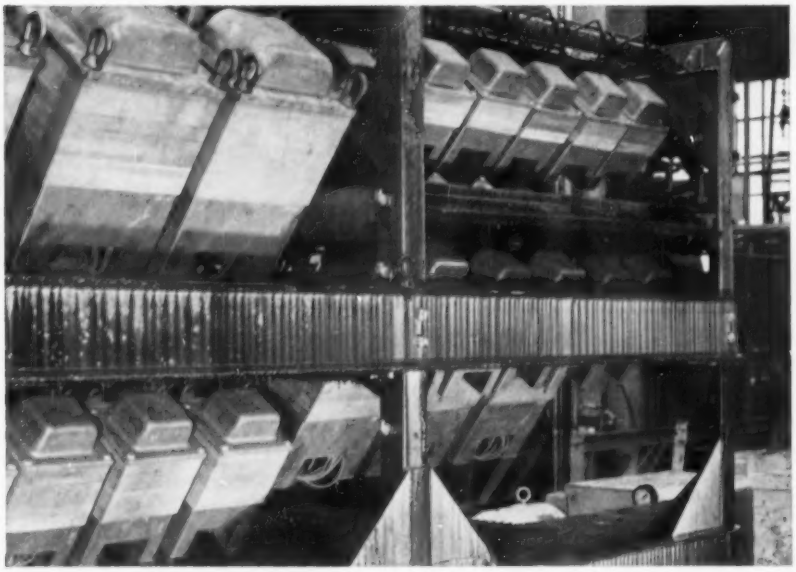
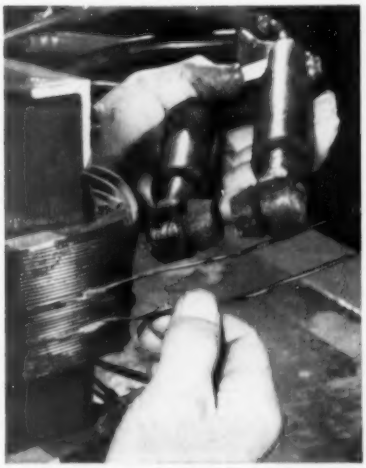
SQUARE D COMPANY

Dry-Type Transformer NEWS

New Line of G-E Voltage Stabilizing Transformers



Standard design will stabilize a 30% voltage change to 1% nominal within 1½ cycles

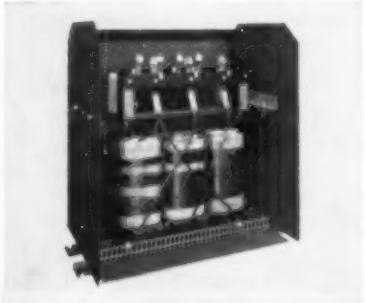


G-E voltage stabilizing transformers are tested to find the proper turn ratio on the secondary coil. A tap lead is then brazed to this turn to give positive ±1% turn ratio.

NEW VACUUM IMPREGNATION PROCESS GIVES G-E DRY-TYPE TRANSFORMERS LONGER LIFE

G-E dry-type transformers now give even longer life because the entire core and coil assembly is thoroughly impregnated by an automatically controlled vacuum-pressure process which removes all moisture, gives higher insulation strength and combats corrosive atmospheres. Varnish insulation penetrates the entire unit, and not merely the exposed surfaces. These units available in all standard ratings.

NEW TYPE D TRANSFORMERS EASY TO CONNECT, SIMPLE TO MAINTAIN



Both the top and sides of the new square case design are easily removed to simplify installation and maintenance. Connections are easily made to solderless connectors in the large, roomy wiring compartment. Thus, as plant power requirements change, G-E Type D transformers can be readily moved to new locations. See your distributor, he has most popular ratings in stock.

With G-E voltage stabilizing transformers in the circuit, control voltage can be held high enough to prevent relays and solenoids from dropping out under adverse line disturbances. Lightning is a typical example of a disturbance which occurs in most parts of the country. As the lightning charge bleeds off the line through arresters, the line voltage may drop to as low as 30% of normal for a period of approximately 2 to 20 cycles. Properly applied, G-E voltage stabilizing transformers will hold the voltage level up sufficiently to keep the relays locked-in.

G-E voltage stabilizing transformers are available in standard ratings from 15 to 10,000 volt-amperes.

For further information write General Electric Company, Section 410-23, Schenectady 5, New York. Ask for Bulletin GEA-5754.

GENERAL ELECTRIC